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The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1102 16th Street, N. W., Washington 6, D. C.

VOLUME XXXV NO. 8

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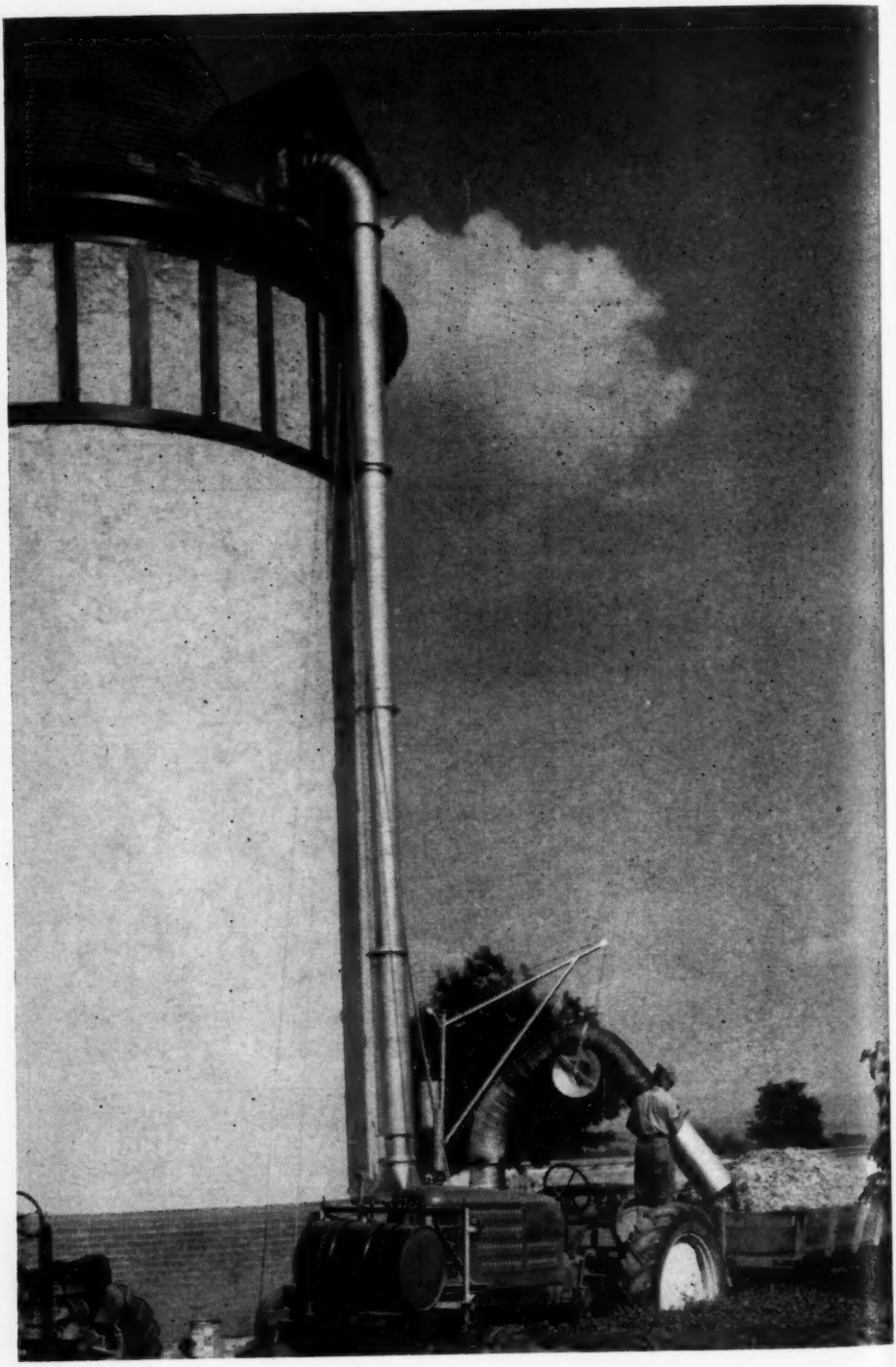

Shooting High!

Better Crops with PLANT FOOD

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Time Has Improved . . .

Tillers and Tellers

Jeff McDermid

IT was once an old-fashioned idea that bankers and farmers were as hard to bring together in harmony as fire and water or weeds and crops—or in a modern metaphor—north and south Korea. Even though a cow might be grazing in the bank's front lawn and you could see the smoke of threshing engines from the cashier's window, the ties of a common bucolic background did not always unite the tiller and the teller.

It was along in those ancient times that some of the cooperative production credit systems took root and the National Farm Loan Associations were launched with initial Government capital. There were inherent stubborness and prejudice on both sides. The fact that many country bankers laid the cornerstones of their enterprises on successful farm operations of their own did not signify that they were eager to take any kind of collateral or grant any length of life or easy interest rates to all their country customers.

Quite the contrary in all practical counts! For if one is a top-notch expert in a complex industrial field he is the first one to scan the financial horizon for hazards, or find risks inherent to the business—considerably more so when old Dame Nature sits in as an unpredictable partner. This is not to say that rare discrimination was not often made, and that the banker usually placed reliance on his hunch in regard to what really amounted to "character" loans. But, of course, his ledgers reminded him not to get sentimental when cents were concerned, because

the best and most honest characters were as much in the pathway of unforseen depressions and droughts as the loosest and the laziest of his importunate borrowers.

MY own kid recollections of a country bank stem to the period prior to marble floors, walnut and mahogany trims, murals of local scenery on frescoed walls, heavy steel vaults, gold-lettered desk names, and a beauteous damsel deftly sorting lucre with lacquered fingernails. Our bank was in a frame shack with a high "false front," its plain interior resembling the postoffice, with a small room at the rear where they put the client through the wringer before hanging him up on the best line of credit he deserved.

Financial life was simple—maybe too simple, then. Farmers needed much less credit for much fewer costly equipments and materials. A youth could inherit or rent a farm and eke along with a team or two, a few common cows and hogs, a little set of machinery, some harness and axle grease to match his faded overalls and elbow grease—and go to it. There were no Joneses to keep up with, and checkbooks were as scarce as account books. You can consult those famous New York State records kept on the operating costs of a group of farms in relation to net income and investment and see what a load the land tiller assumes under modern, high-pressure agriculture. This brings the tiller more often to see the teller, and if you remark that financial life is burdensome, their answer is: "You're telling me?"

Back in the 1900-1910 decade there were not so many lending agencies open to the farmer seeking a real estate mortgage. At that time the total mortgage debt farmers were carrying was about $3 billion dollars and the interest charges were close to 23 cents an acre for all land in farms, based on the existing debt, whether mortgaged or not. The land boom had not started. Life insurance companies had but small investments in farm mortgages. Federal credit agencies were not yet in business. So the other main taker of farm paper was the individual looking for a safe place to hatch out his nestegg.

From 1930 on through 1945, federal land banks came into being and caught up fast, so that they had from $1 to $2 billions outstanding in mortgages. Along with this rush of new business in the federal banks, the life insurance concerns toted a heavier load through these decades up through 1945. Their totals hit $2 billion one year and ran an average of $1 billion right along. Only once, in 1920, did the private banking system carry as much as $1 billion in farm paper. It ran close to half a billion dollars until 1947. Thereafter the insured commercial banks began to build up their farm business slowly until the records indicate they held almost a billion dollars of such security in 1951.

STILL the individual and the "miscellaneous" lender occupy the top spot in our present farm mortgage field. Life insurance companies rank second. Today the insured and uninsured banks together own more farm mortgages than the federal land banks. The subsidiary, the Federal Farm Mortgage Corporation, built up its volume steadily from 1935 on through 1940 and then slackened. Authority to make new loans by the FFMC expired by law in July 1947. The U. S. Treasury has been repaid all it ever advanced for this mortgage deal, with many millions more as profits.

Farm mortgage debt has been rising, but its present $5.8 billions is a good long ways from the tip level of $7 to $9 billions chalked up on the records during those corn-burning, moratorium nightmares of the big depression period. In general, the existing farm mortgage debt is believed to be about 55 per cent of the highest peak of history—that of January 1923. But not all states boast as relatively low

farm mortgage debt as that, the ones nudging the old record closer being New Hampshire, Rhode Island, New Jersey, Delaware, the Virginias, North Carolina, Florida, Tennessee, Alabama, Louisiana, and New Mexico.

No good reason is given as to why this situation varies as it does by states and regions. It can't be shown that the states named have greater changes in land values or a greater number of farm transfers.

Forced sales of farms do not enter the picture much yet and may not do

so while the keen demand for farm products rules the economy. Voluntary sales have risen about 6 per cent or more in the past year. Values quoted for farm real estate give some inkling to the real reason for higher mortgage debt. Such values advanced 15 per cent or more as a national average during 1950-51. About 65 per cent of the farm sales were financed in whole or in part with credit. This is a trifle higher than the average in the post-war years.

More inflated acre values are bound to come as long as the era we are in continues in its tempo and turmoil. This raises many knotty questions that the banker and the farmer must face, and for which they must find some kind of reasonable answers. The heavy capital requirements of farming today, its enormous risk, and the net income with which to pay loans are going the rounds of debate, carrying with them the most perplexing of all questions for the future—how can a capable young person get into farming as an owner, and how long can he stay there after he gets there?

ASIDE from the full realization that to succeed on this margin and meet this stiffer hazard calls for a high degree of education and experience, we have another morsel to chew upon. How soon are we going to invent and use a new kind of mortgage credit, maybe one that will not require the farmer to ever pay off his debt in full; but the mortgage will run for 99 years, with perhaps a suitable amortization plan of funding principal and interest regularly. What are we going to drift into, or be swept into, in case the rapid flood of inflation destroys all those familiar financial high-water marks of vanished days? This is a gnawing conundrum for the banker to ponder, and if somebody starts the change and sets the pace, he and all the biggest farm land investors must keep step or find better places to invest. And we doubt if there is anything supported by a surer demand than agriculture, which is underwritten by the alimentary canal. (I also call that "elementary.")

Of course, this doesn't always mean that inflation is one-sided. The gross and net incomes have risen also with the general advance in farm prices. Likewise the ability to produce more per unit of manpower as well as per acre is made possible by the greater investment farmers have in the modern things. So if there are no terrific weather reverses or sudden depressions, this larger volume of goods for sale by farmers gives them a larger gross income from which to meet overhead. Naturally, the shrewd money-lender

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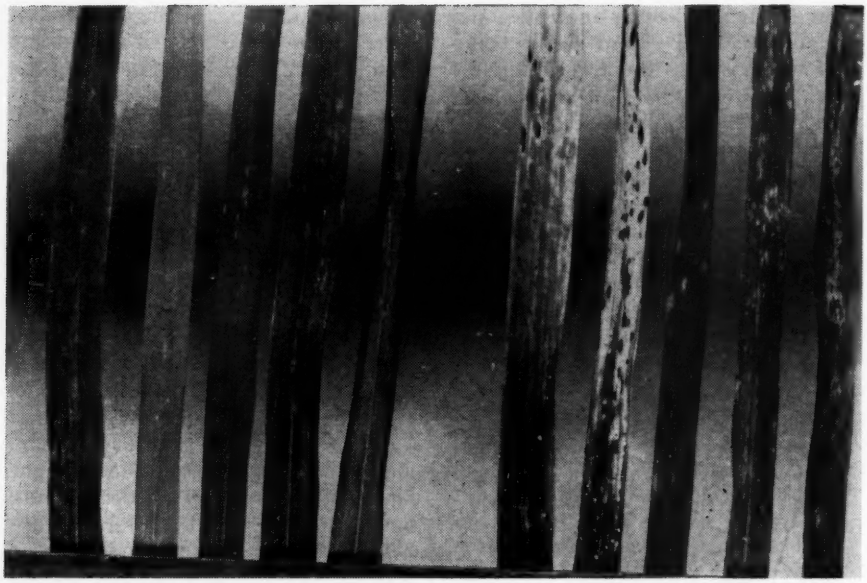

Fig. 1. Healthy wheat plants (left) on land fertilized with potash resisted infection by mildew. Severe infection (right) occurred on land that received no potash.

HEALTHY PLANTS Must Be Well Nourished

By C. M. Woodruff

Department of Soils, University of Missouri, Columbia, Missouri

PLANT diseases are commonly associated with some microbe or insect that attacks the plant. In the "fight" on these enemies, the diseased or infected plants are often sprayed or dusted with a compound which is lethal to the organism but can be tolerated by the plant. A currently hopeful approach to the control of plant diseases is looking to the breeding of disease-resistant varieties. Little by little, evidence and experience are accumulating to suggest that some of the plant diseases may be the sequel to the deficient mineral nutrition of the plant.

Organic materials that grow in nature are attacked and decomposed by a host of organisms as soon as life wanes or ceases to exist. Single cells or tissues in the growing plant which weaken or die through certain nutritional deficiencies provide ready seats of infection for plant diseases.

The essential nutrient elements which a plant absorbs from the soil either enter into combinations with other elements to form physiological or anatomical parts of the plant or they function in physiological processes as ions, catalytic agents, enzyme activators, and

so forth. A single element may play a number of different roles. Of the three major plant elements, nitrogen, phosphorus, and potassium, the nitrogen and phosphorus enter definitely into combinations with other elements to form compounds which are a part of the anatomical structure and physiological activities of the plant. Both of these elements are essential in the processes of cell multiplication and reproduction. They form integral parts of the protein molecule. Potassium, in contrast, is an element which exists primarily as a diffusible ion in the plant. Little is known about the tendency of alkali metals to form undissociated chemical compounds. However, the role of potassium in the physical biochemistry of proteins is well established.

Translocation of Elements

If the supply of available phosphorus or nitrogen in the soil is exhausted, growth of the plants either stops or continues through the dissolution and translocation of these elements from the lower leaves of the plant toward the growing tops or the reproductive organs. Plant tissue that is weakened or dead through deficiencies of nitrogen and phosphorus is not such a fertile site for disease organisms. They also require nitrogen and phosphorus for their own growth and reproduction. The "fired" leaves of corn will hang bright and yellow until worked into the soil. Even here decomposition of such buried organic matter worked into the soil is slow, if extra nitrogen is not available. Cornstalks plowed under for wheat in the fall have been turned up apparently undecomposed the following year in preparing for the second wheat crop. But cornstalks well supplied with nitrogen begin to mold and decompose while standing in the field following their maturity.

The role of potassium in the plant is a regulatory one. Potassium is essential to the physiology of the plant, but is not a part of the plant anatomy. In this respect its function resembles that of certain of the minor elements. It is in this group of the plant nutrients that the potential health of the crop resides. Inadequate nitrogen and phosphorus represent plant starvation in the same sense that an animal is short of feed to build its body. Inadequate potassium represents sick and dying tissue because of a disturbed physiology. The condition of a potassium-deficient plant is analogous to the condition of an animal that lacks salt. The sodium of the salt does not combine to form an essential compound in the anatomy of the animal but its importance in the physiology of the circulatory system is undisputed. A deficiency of potassium in the plant disturbs the reactions of synthesis, translocation, and metabolism whereby the products of the leaves feed the growing and metabolizing cells of the root and top of the plant.

Fig. 2. Sweet clover grown without the benefit of potash fertilizer (left) suffered not only in total growth but also in its susceptibility to root rot. The decomposing taproots were pulled up easily. But where potash and phosphorus were used in combination (right), the roots could be removed only with a spade. Phosphorus without potash (center) was helpful but inadequate.

Sources for Infection

The dying leaf tissue of a potassium-deficient plant provides a ready source for infection by microorganisms. The cells contain the nitrogen and phosphorus necessary for the reproduction of the organism along with the carbohydrates needed for metabolism and energy. Wheat growing in plots on Sanborn Field that received no potash was attacked by mildew (Figure 1). This produced prominent black spots on the leaves in the advanced stages of the attack. A count of the infected areas on the leaves of the unfertilized wheat showed an average of 17½ colonies per plant whereas wheat fertilized with potassium was infected to the extent of only 2½ colonies per plant.

Plant roots, although they are in direct contact with the potassium supply of the soil, are dependent upon the synthesis and translocation of material from above-ground parts of the plant. Roots which are weakened through a disturbed physiology of the above-ground parts of the plant brought on by a potassium deficiency are readily susceptible to infection. Root rot of sweet clover was shown by Albrecht and Klemme* to be associated with inadequate fertilization with potash (Figure 2). Root rot and lodging of corn have also been traced to deficiencies of this nutrient.

The grain of a plant represents an accumulation of products synthesized in the leaves. Deficiencies of potassium in the soil lead to a disturbance of the physiology of the plant which prevents the filling of the kernels of grain. Potassium-deficient corn produces ears with unfilled tips that protrude through the end of the husk (Figure 3). These protruding tips are sources of infection for diseases and ear-worms. They also provide easy entrance for rainwater that trapped in the husk causes the corn to rot.

*Albrecht, W. A., and Klemme, A. W.—Root Rot of Sweet Clover Reduced by Soil Fertility. Better Crops with Plant Food, February 1948.

There are other visible effects of a potassium deficiency in addition to the infection, by disease organisms. Weakened straw in small grain and weakened stalks in corn were correlated with potassium-deficient soils in early studies with lime and sweet clover at the Missouri Agricultural Experiment Station. Similar results have been obtained more recently where heavy amounts of nitrogen and phosphorus fertilizers were applied to a soil that was moderately low in potassium according to the soil test (Figure 4). In the latter study, a count of the cornstalks down at harvest time showed 67 per cent of them broken over as the result of either weakened stalks or root rot. The sensitivity of a corn plant to potash treatments was noted in the early stages of maturity. Where the soil was treated with muriate of potash at 200 pounds per acre, the shank that supports the ear was broken over on all stalks, whereas with 600 pounds per acre, 90 per cent of the ears remained erect until harvest.

The Delivery of Potassium by the Soil

The first problems with potassium on the fertility plots of the Missouri Agricultural Experiment Station appeared when lime and sweet clover were introduced in 1923. Phenomenal increases in yields of corn were obtained following the sweet clover for the first few years of the study. Thereafter, the yields declined and severe lodging of the corn occurred. A complete analysis of the cornstalks after a soil-treatment period of 10 years showed a potassium concentration of 1.5 per cent in the stalks from the untreated check plot, 1.0 per cent in the stalks from the manured plot, and 0.2 per cent in the stalks from the plot that had been limed in order to grow sweet clover as a green manure for the corn. All crop residues had been removed

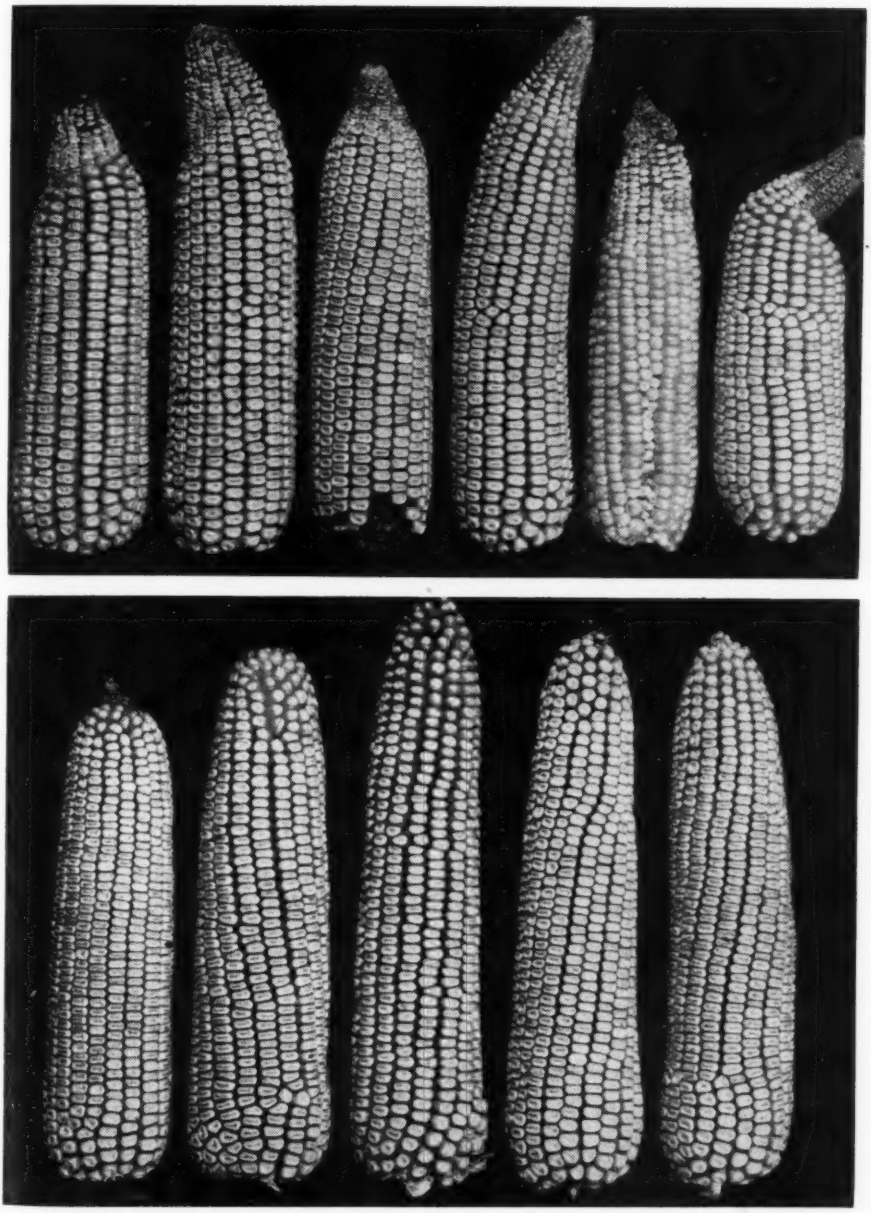

Fig. 3. Potassium-deficient corn (above) produces unfilled ears that often protrude through the husk where they are attacked by ear worms or rot because of water that enters the husk before harvest. Corn fertilized with potash (below) produced well-filled ears.

during the preceding 10 years and no fertilizer had been added.

In order to study this question in greater detail, a complete set of new fertility plots was established in 1936. These plots included comparisons of a number of different crop rotations. Each crop rotation had as its variables.

Fig. 4. Corn root rot and weak stalks caused by a deficiency of potassium. The soil which was low in potassium, according to soil tests, was fertilized with 300 pounds per acre of ammonium nitrate and 500 pounds per acre of superphosphate, but no potash was added. The available potash supplies of the soil are depleted rapidly when production is stepped up through the use of fertilizers that do not include potash.

the soil treatments of lime, lime and phosphorus, and lime, phosphorus, and potash.

The effects of the fertilization with potash appeared of little significance during the first 10 years of the study. In recent years, the crops that were planted without potash fertilizers in the rotations where large amounts of forage were removed from the land annually have developed severe potassium deficiencies (Figure 5). Large yields of grain induced through the use of nitrogen fertilizers have brought about a rapid depletion of the available potash reserves of the soil. Small grain and lespedeza when utilized as pasture have not reduced the available potash level of the soil over a 10-year period of study. But when the grain, including the straw, was removed and only the lespedeza was pastured, then the level of available potash was reduced to half of its original amount over the 10-year period of the study.

These results emphasize the importance of returning crop residues to the soil as a means of maintaining a balance between the delivery of potassium by the weathering minerals of the soil and the removal of it by crops. The results also emphasize the impossibility of knowing whether or not the level of available potassium in the soil is being maintained under a specific cropping system without the use of soil testing as a guide. The indiscriminate use of potash fertilizers, although it will insure adequate supplies of potassium for the plant, fails to take advantage of the delivery of potassium by the soil which in most instances contains abundant amounts of unavailable potassium.

The demands of strong healthy plants are not confined to potassium alone. Lime, phosphorus, and nitrogen each play their part and must be supplied.

Even the less familiar minor elements cannot be neglected as improved practices are extended to the less fertile soils. But wherever crops are grown, well-nourished plants are healthy plants. They are their own line of defense against many of the problems that beset the producer of poorly nourished crops.

The benefits of a well-balanced and adequate supply of plant food extend well beyond the results as measured in terms of higher yields. These include resistance to disease, stronger stalks, and well-filled ears. Well-nourished, healthy crops grow up and root down so that the low-growing weeds and wild grasses perish in the struggle for light and water (Figures 5 and 6). The protection afforded the land by a healthy, vigorous crop eliminates erosion, which is nothing more than a symptom of depleted fertility. The philosophy of well-nourished plants is summed up well in the sage advice that a farmer offered his neighbor who was complaining about a den of muskrats that had destroyed a small field of corn. "Bill, why don't you fertilize that land, then you won't miss the corn those muskrats eat?"

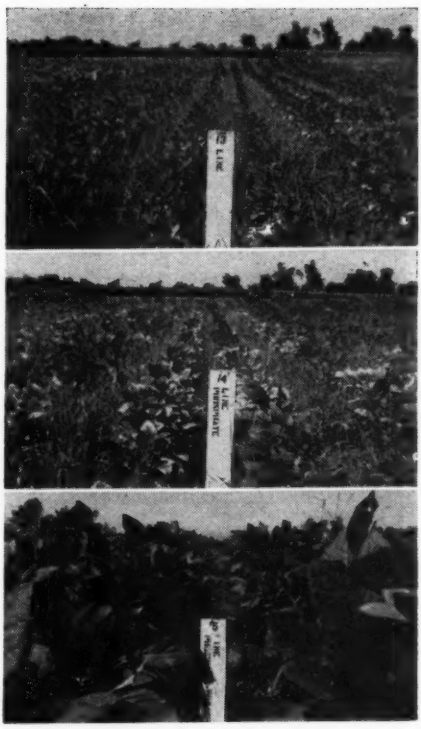

Fig. 5. Large yields of crops made possible through the use of lime and phosphorus over the past decade are not limited by potassium. Potash fertilizer provides the element needed to enable the soybeans to outgrow the crabgrass which could not be removed because of wet weather.

Fig. 6. Healthy crops are the rule rather than the exception if plants are well nourished. "Wet sickness" of corn is usually traceable to deficiencies of nitrogen and potassium. The wet weather of June and July that produced the floods of 1951 also produced good corn on plots where potassium was supplied as a fertilizer.

Producing Small Grain More Efficiently

By W. H. Rankin

Agronomy Department, North Carolina State College of Agriculture, Raleigh, North Carolina

RESEARCH and development precede quantity production of the most wanted and profitable products. When a superior article reaches the market, the less desirable and usually older competitive ones are superseded by its better qualities and characteristics. Likewise, small grain research is developing strains of wheat, oats, and barley, with more disease resistance, more tolerance to freezing temperatures, and stiffer straw that resists lodging, which are taking the place of older strains. All of these characteristics contribute to higher yields and more efficient production.

With better automobiles have come better highways on which to use them. So with better small grains, there is a need for better cultural practices for them to perform most efficiently. Herein are potentialities for doubling the per-acre yields of small grains.

Proved by Experiments

Experimental work has proved that yields more than double the average are easily attainable on fields and farms throughout the small-grain-producing area of North Carolina. For 15 consecutive years in field-scale production at the Piedmont Experiment Station, Statesville, N. C., the average yield of wheat has been 31 bushels per acre, barley 35 bushels, and oats 63 bushels. These may be compared to the State averages of 15 bushels of wheat, 24 bushels of barley, and 28 bushels of oats for the same period.

At this Station in 1949, a season classified as unfavorable for small grains, yields of 35 bushels of wheat per acre, 66 bushels of barley, and 80 bushels of oats were grown. These yields were produced on a soil like thousands of acres of other red uplands of the Piedmont plateau.

The principal causes of low and unprofitable yields of small-grain crops have been determined for North Carolina conditions. Means for correcting the causes and overcoming the deficiencies are available from research on 60 or more fields during the past eight years.

There are five major factors affecting small-grain yields: Seedbed preparation; quality and character of seed; seeding date; soil fertility and fertilizer practices used at seeding; and the available nitrogen supply during the period of maximum growth March, April, and early May. If any one of these factors is limiting, then conditions with respect to all others fail to result in high yields. Yields can be increased only if all conditions are near optimum.

TABLE I.—A COMPARISON OF GOOD AND POOR PRACTICES ON YIELDS OF WHEAT AND OATS.

	Good practices	Poor practices	Increase due to good combination
Wheat....	31 bu.	12 bu.	19 bu.
Oats.....	63 bu.	23 bu.	40 bu.

Fig. 1. Date of seeding influences yield of wheat and oats.

Above	left:	Wheat	seeded	Oct.	20	Yield	42	bus.	per	acre
	right:	"	"	Nov.	20	"	13	"	"	"
Below	left:	Oats	"	Oct.	1	"	65	"	"	"
	right:	"	"	Nov.	20	"	28	"	"	"

A number of demonstrations have been conducted comparing an unfavorable combination of practices, similar to that used by many farmers, with a favorable set of conditions like that recommended by the Experiment Station and Extension Service. These demonstrations produced further proof that average yields of wheat, oats, and barley can be more than doubled. Higher yields per acre usually reflect themselves in a lowered cost per bushel.

Small grains are members of the grass family and as such respond to liberal supplies of nitrogen. On a depleted upland soil that only produced 8 bushels of wheat per acre when fertilized at seeding, a yield of 29 bushels was harvested where adequate nitrogen was supplied. Nitrogen may be obtained either through such legumes as red clover, sweet clover, and exceptionally heavy crops of lespedeza or by purchasing it in commercial forms.

The use of more seed or more fertilizer will not overcome late seeding. Neither will seeding on time overcome the deficiency in fertilizer or a lack of nitrogen.

When seedbeds are well prepared, high-yielding superior performing varieties are used, seeding is done at the optimum time, fertilizer is used according to soil conditions and crop history, and a supply of nitrogen is provided for the plant to use during the period of maximum growth, higher and more efficient yields will be produced.

Fig. 1. Tall Telephone peas growing on muck near Puyallup, Washington. Good soil, good climate, grower know-how, plus 1,200 pounds of 3-10-10 per acre, produced this fine crop.

Fertilizers for Vegetable Crops—Rates, Placement, and Ratios

*By Karl Baur, F. T. Tremblay, and George Wickstrom**

WESTERN Washington farmers have supplied fresh vegetables for local and distant markets for many years. The development of the canning industry in the late twenties and the quick freeze industry in the thirties greatly enlarged the outlet. Today, the production of vegetables for processing is an important part of the agriculture of western Washington. It is a growing industry and a good business that adds much to the stability of the agriculture of the area.

Growers and processors alike are well aware of the fact that top quality in the finished product must be maintained, if the products of the Northwest are to hold and gain markets. Fortunately for the area and those concerned, a combination of soil and climatic factors plus the "know-how" of growers and processors make it possible to supply high-quality products to buyers throughout the country. The bright green frozen peas from the Northwest find a ready market. No area packs a more attractive green bean than the famous Blue Lake variety that reaches its perfection in western Oregon and western Washington.

*Director of Research, Pacific Supply Cooperative, Portland, Oregon; Assistant Soil Scientist, Western Washington Experiment Station, Puyallup, Washington; Agronomist, American Potash Institute, Sumner, Washington respectively.

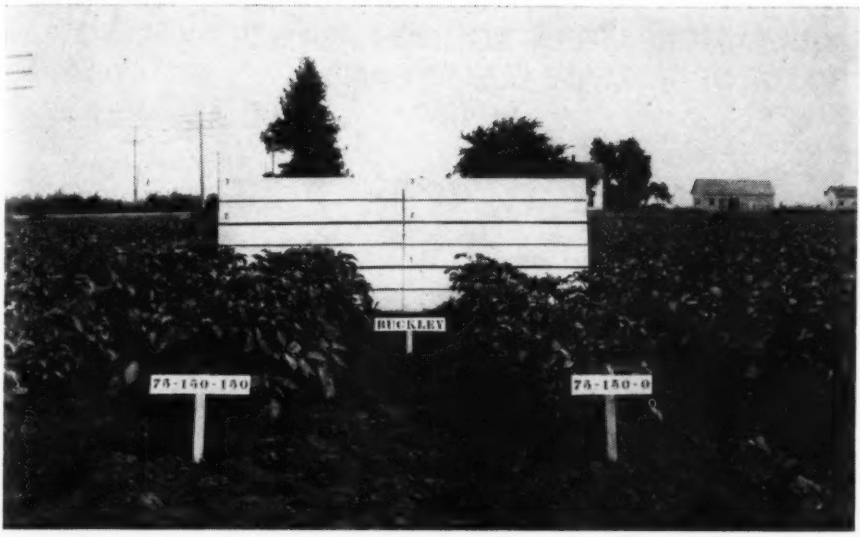

Fig. 2. The plot on the left received 750 pounds of 10-20-20 per acre, and the plot on the right, 750 pounds of 10-20-0, near Buckley, Washington. The response to potash is shown by the differences in growth.

The cool weather which prevails during sweet corn harvest is a real aid in packing high-quality corn. Lots of natural sugar makes sweet corn sweet. The speed of conversion of the sugar in sweet corn into starch is determined largely by the temperatures which prevail between the time the corn is harvested and the time it is processed. The higher the temperature, the more rapidly does this undesirable change occur. The higher the temperature, the shorter the period in which the corn is at prime maturity.

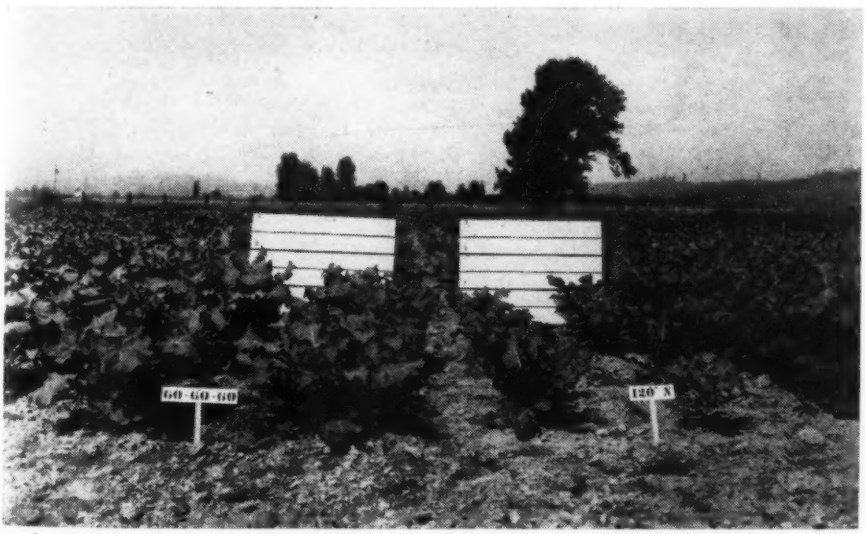

Fig. 3. Nitrogen alone was not enough for good growth of broccoli in this field near Puyallup. The plot on the left received 600 pounds of 10-10-10 per acre, the plot on the right 120 pounds of actual nitrogen and 6 sacks of ammonium sulphate per acre.

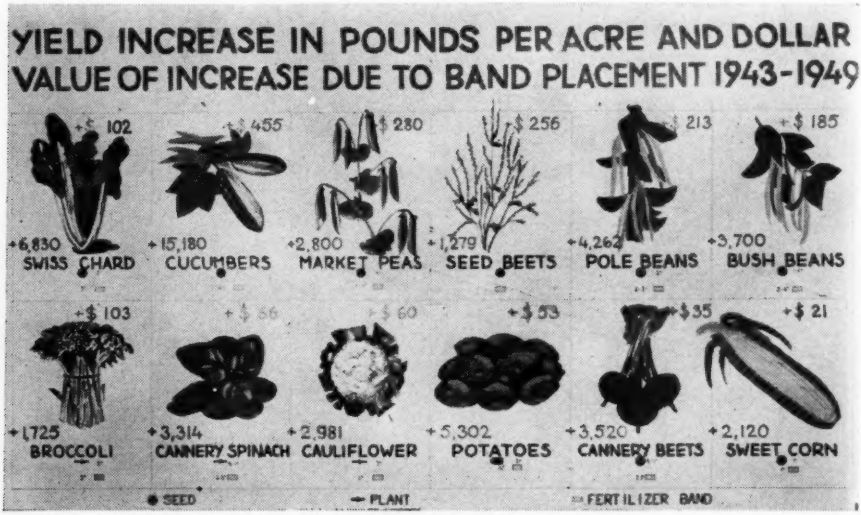

Fig. 4. Results of fertilizer placement work in western Washington carried on from 1943 to 1949 by the Western Washington Experiment Station and U. S. Department of Agriculture.

Green sprouting broccoli, a newcomer among the processing vegetables, is planted so that most of it is harvested in the cool months of September, October, and November when the shoots are firm, crisp, and green.

Grower "know-how" is important no matter what the crop. It is particularly important in the efficient production of vegetable crops such as Blue Lake beans which have very high fixed acre production costs. When fixed costs include items such as poles, posts, wire, strings and insecticides, in addition to usual costs of land prep-

(*Turn to page* 40)

Fig. 5. The effect of phosphate application (banded) on corn growth near Puyallup, Washington. The corn on the left received nitrogen and potash but no phosphate, while the corn on the right received a complete fertilizer.

Fig. 1. Fertilize the entire rotation! This shows contour strips in the rich Conyngham Valley section of Luzerne County, Pennsylvania. The first demonstration in this valley was laid out by the county agent in 1937.

Rotation Fertilization

By James H. Eakin, Jr.

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THE "Big Three" of soil productivity maintenance are lime, fertilizer, and organic matter. Haphazard systems of soil management may provide adequately for one or even two of these essential factors; but to neglect the third may seriously limit crop production. The use of lime and fertilizer will be greatly enhanced if provisions are made for the replenishment of organic matter. Research has shown that crop yields may be limited as often by poor soil physical condition as they are by lack of essential plant nutrients. Conversely, if adequate plant nutrients are not used, lime and organic matter cannot work efficiently to produce high yields.

Lime needs are comparatively easy to correct, and many of our farmers are doing a good job of liming their fields. A soil acidity test will show the amount of liming materials needed. On the other hand, many soil management programs do not make adequate provision for replenishment of organic matter and plant nutrients. Perhaps these two soil productivity factors are not properly understood since they must be considered at the same time. For instance, many farmers tend toward a short rotation, high fertilization, and little sod. They attempt to substitute plant nutrients for organic matter. The former can be purchased in commercial ferilizers; the latter can-

not. Such a program may increase total production for a few years, but as the supply of organic matter decreases, fertilizer efficiency drops sharply.

What is the explanation for this drop in the crop-producing power of fertilizer? It takes about five million pounds of water to produce 100 bushels of corn. Soil robbed of organic matter through insufficient use of sod crops cannot efficiently absorb rainfall. It lacks spongy humus for holding water. When crops cannot secure enough moisture, fertilizer additions will not increase yields; in fact, under this condition, fertilizer salts may actually decrease yields. For this reason and many others the maintenance of organic matter at a level that is normal for any particular climate is essential for efficient crop production.

Several other reasons why organic matter maintenance should be considered one of the basic objectives of good soil management can be cited: (1) Improves soil aeration; (2) allows maximum expansion and development of plant roots; (3) absorbs toxic substances from the soil solution which could be injurious to plant development; (4) provides a storehouse of nitrogen as well as other plant nutrients; (5) stabilizes soil granules; this, in turn, helps to prevent erosion.

To study further the inter-relations between organic matter and fertilizer, let us cite another example of poor management. All too frequently farmers fertilize their cash crops, which is a good practice, but fail to apply any fertilizer to their sod crops. This has resulted in hay yields that average only from 1 to 1½ tons per acre. Much of this hay is of doubtful quality because of the poor performance of the legumes in the mixture. This half-way fertilization practice also results in lower yields of cash crops because the poor sods turned under are shy in organic matter. With such a program the farmer loses every time. It takes commercial fertilizer to produce humus, and it takes humus to produce crops.

Any effective system of soil management must take into consideration all of the factors that contribute to successful crop production. The best entry into an efficient soil-building program is by way of the crop rotation. The rotation should employ, at the minimum, 25 per cent of the cropland in sod at all times. The fields should be fertilized according to the rotation used. Instead of considering each crop individually, the entire rotation should be kept in mind. Every acre of cropland should receive an annual application of fertilizer. Special effort should be directed toward higher producing sods as these automatically increase yields of cash crops and total production.

Pennsylvania's new plan of rotation fertilization attempts to keep the basic fundamentals of soil productivity in line at all times. All crops receive an ample supply of lime and plant nutrients. The fertilization system is not recommended for those farmers who do not employ sod crops in their rotations.

An example of how rotation fertilization works can be cited in the corn, grain, hay rotation. Any one of the following conditions may exist on potential corn land—and each condition requires a different fertilization program:

1. Legume sod, (6-8 tons phosphated manure)
2. Grass sod, (6-8 tons phosphated manure)
3. Legume sod, not manured
4. Grass sod, not manured

If the legume sod has consistently received good fertilizer and manure treatments, high rates of fertilization generally will not be a paying proposition. Under this condition 100 to 200 pounds of 5-10-10 per acre applied in the row will be sufficient fertilizer to produce the most efficient corn yields. Number 4, poorest situation of those listed, usually involves a deficiency of

Fig. 2. Orchard grass-ladino pastures have been maintained for periods of 10 to 15 years with annual fertilization and good management practices.

nitrogen. Plowing down 50 to 75 pounds of actual or elemental nitrogen per acre will supply that plant nutrient. In addition, 300 pounds of a 5-10-10 fertilizer per acre should be applied in the row. The first step toward rotation fertilization has been accomplished; the crop was fertilized according to the specific condition that existed.

In planning a small grain fertilization program, either of the following two conditions may exist:

1. Small grain seeded to hay or pasture.
2. Small grain, not seeded.

The first condition presents two crops to be fertilized; the second, only one. When small grain is seeded to a legume grass mixture there is an excellent opportunity to place fertilizer in the feeding zone of next year's hay crop. Therefore, it is recommended that 300 pounds of 0-20-20 fertilizer per acre be plowed down or drilled deeply when preparing the seedbed. In addition, 300 pounds per acre of grain fertilizer, such as 5-10-10, 4-12-8, or 2-12-12, should be drilled when the small grain is sowed. If the small grain is seeded alone, 300 pounds per acre of a complete fertilizer, such as 5-10-10, should be sufficient in most cases. If lodging of the grain has been a problem in the past, fertilizers carrying no nitrogen should be used.

After the first year hay or pasture crop is removed, it is time to consider replacing in part those plant nutrients that have been removed. In Pennsyl-

Fig. 3. Orchard grass roots. Grass roots and organic matter are the key to crop production.

vania, good results have been obtained by topdressing those hay fields in the fall of the year. About August 15 to September 15, 400 pounds per acre of 0-20-20 fertilizer should be applied. A similar application is recommended each fall as long as hay is to be cut the next year. This timing of fertilizer application enables the legume plants to build up sufficient carbohydrate root reserve to winter over and shoot a good top the next spring. It also means the soil is receiving fertilizer when plant-nutrient reserves are at their lowest point. Cooler weather and increased rainfall will enable the legumes to make quick use of the fertilizer.

Fertilizer

To many farmers, 400 pounds of 0-20-20 per acre per year seem to be a great deal of fertilizer. However, in view of what is coming from the land in plant nutrients they might think otherwise. One ton of alfalfa hay removes about 45 pounds of potash per acre. Suppose a yield of 4 tons is removed. This would represent a removal of 180 pounds of potash. Through weathering processes the soil will return approximately 20 to 50 pounds per acre per year. Erosion, leaching, and fixation by clay minerals will cut down on that supply. Six tons of well-preserved farm manure will return about 60 pounds of potash of which approximately one-half will be available the first year. With the 4-ton yield of hay there will be 100 to 130 pounds of potash that must be replaced. These figures represent only one year's production. When one considers a 20- or 30-year period, it is easy to see why certain farms which once produced good alfalfa and clover hay yields cannot produce half a crop now.

Examples of crop situations cited in preceding paragraphs have been used merely to show how rotation fertilization applies under specific conditions. Far too many soil-improving practices are based on generalizations or habit. Rotation fertilization is based upon fitting the practice to the situation that exists. Over the last 50 years, agricultural research has developed much information on use of fertilizer. This information has been disseminated to farmers through extension teaching.

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Fig. 4. Nitrogen starvation on the right, normal corn on left. If the entire rotation is fertilized including annual application of plant nutrients for grass-legume mixtures, cash crop production will remain high with moderate fertilizer applications.

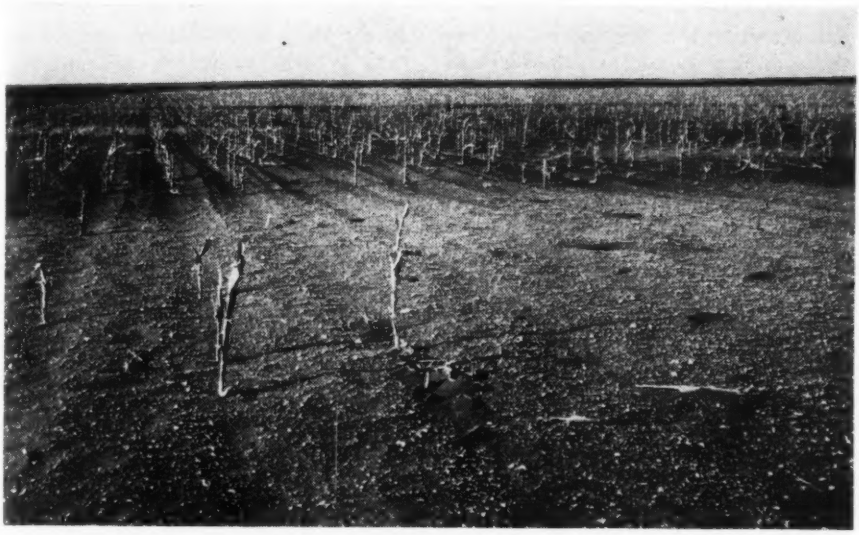

Fig. 1. The wind acts as a fanning mill, removing the organic matter, silt, and clay and leaving the sand and gravel.

Soil-fertility Losses by Erosion

By J. H. Stallings

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THE importance of fertility erosion —caused by the action of wind and water sorting, sifting, and removing the lightweight fertility-bearing portion of the soil while leaving sand and other heavy material—is not fully appreciated. The loss of this fertile material may be the most serious immediate effect of soil erosion. The amount of topsoil may be reduced materially by the removal of sand, gravel, and other inert material over a period of years, but the removal of organic matter and plant nutrients decreases soil fertility most rapidly.

The most fertile portion of the soil is the part that is often removed first by wind and water in the erosion process. The soil at the surface of the ground is stirred by wind and rain water and sorted into different-sized particles. Due to its turbulent nature, the action of wind on the soil is similar to that of a fanning mill. It removes organic matter, fine silt, and clay particles, and leaves the larger, heavier sand and gravel (Fig. 1). The lighter, more fertile fractions are picked up and lifted into the pathway of higher air currents, which often carry them for hundreds and sometimes thousands of miles (Fig. 2). The coarser, less fertile particles skip, slide, or roll along the surface and often pile up in drifts.

Raindrops falling on bare soil splash and stir the soil particles at the surface into a muddy, watery mixture. Much of the coarser, heavier material settles

out as soon as the turbulence caused by the splashing raindrops subsides sufficiently. The smaller, lighter particles which contain the fertility elements remain in suspension and may be floated away—sometimes entirely off the field —by surface flow. Other factors being equal, the average amounts of soil lost through sheet erosion vary in accordance with the violence of the raindrop impacts which stir them into suspension and set them in motion.

Wind Removes Most Productive Part of Soil

Soil material deposited on snow and ice at Clarinda, Iowa, by a dust storm originating in the Texas-Oklahoma Panhandle contained 10 times as much organic matter, 9 times as much nitrogen, 19 times as much phosphoric acid, and about 1.5 times as much potassium as there was in the dune sand piled up where the dust storm originated (2)[1]. The transported material was much finer and contained no sand whatsoever, whereas the drifting dune that was left behind contained nearly 92 per cent sand.

The sorting action resulted in marked differences, also, between the deposited material and the soil of the virgin grassland in the general vicinity of the storms. The unaffected grass-covered soil contained 79.2 per cent total sand and 19.6 per cent silt and clay. The dust contained no sand and 97 per cent silt and clay. The dust contained more than three times as much organic matter and nitrogen, respectively, as the virgin soil, nearly 5 times as much phosphoric acid, and 1.25 times as much potassium.

Material deposited by the same storm at Hays, Kansas, (about 300 miles from the area of the disturbance) contained 3.7 per cent sand, 67.8 per cent silt, and 25.3 per cent clay, indicating in comparison with that deposited at Clarinda, Iowa, (500 miles from its point of origin) that even the coarser materials in dust gradually settle out as the dust storms move away from their point of origin.

The soil in the drifts resulting from the earlier dust storms in the Texas-Oklahoma Panhandle area was found to contain 24.5 per cent less organic matter and 28 per cent less nitrogen than the virgin soil (6). Other studies have shown that soils which have been drifted by wind have a lower organic matter, nitrogen, and phosphoric acid content than undrifted soil (16), and that dust resulting from dust storms are high in organic matter (17).

More than 75 per cent of the dust collected during a storm in Massachusetts on February 20, 1942, was fine enough to pass through a screen with 300 meshes to the inch (13). This dust contained 4.5 per cent organic matter, which is far above the normal of 1 to 2 per cent for good, fertile soil in the area.

After the Oklahoma dust storm of April 1935 the greatest difference between drift material, cropped soil, and virgin surface soil occurred in the coarse- and medium-textured types (4). The drifts contained an average of 37.8 per cent less silt and clay and 29.3 per cent more sand than adjacent virgin soil. The increase in percentage of sand in the drifts was in proportion to the amount of silt and clay removed by the wind.

Samples of dust collected in Oklahoma during the dust storms of 1930 contained, on the average, 62.5 per cent silt and 14.3 per cent sand (10). The original soil contained 42 per cent silt and 35.4 per cent sand, whereas the drift soil contained only 15 per cent silt and 58.2 per cent sand (Fig. 3). Dust deposited in buildings contained about twice as much material suitable for plant food as there was in the original soil.

After a dust storm in Kansas in 1948 both the drift and eroding soil, which originated principally from sandstone, contained much less organic matter than similar soil in noneroded fields (26). Much of the organic matter in

[1] Figures in parentheses refer to literature cited.

Fig. 2. The lighter, more fertile fractions of the soil are picked up by the wind and lifted into the path of higher air currents which often carry them for hundreds and sometimes thousands of miles.

these soils was carried into the atmosphere and completely removed from the affected area.

As a result of the sorting action of the wind during this windstorm the quantity of particles averaging 0.016 mm. and not exceeding 0.05 mm. in diameter was more than five times as great in the soil from which the drift material was derived as in dunes formed during the storm. Evidently most of the small particles in the wind-eroded soil were removed.

Windstorms removed an average of 0.85 inch of topsoil from fields near Salina and McPherson, Kansas, during March 1950 (26). It was estimated that about three-fourths of this soil was piled into drifts in the vicinity of the eroding field. The rest was carried away, mainly as dust particles ranging up to 0.1 mm. in diameter.

On loess soils virtually all parts of the soil can be removed by the wind. Wind erosion on such soil does not appear to alter appreciably the texture of either the residual soil or that of the drifts. The organic matter content of the accumulated drifts was slightly higher for soils derived from loess than for the residual soil of the windblown fields. The organic matter included not only particles held together with a mineral portion of the loess soil removed by the wind but also loose, finely divided organic residues.

The wind tends to change the texture of non-loess soils by removing silt and clay fractions, and it may deplete

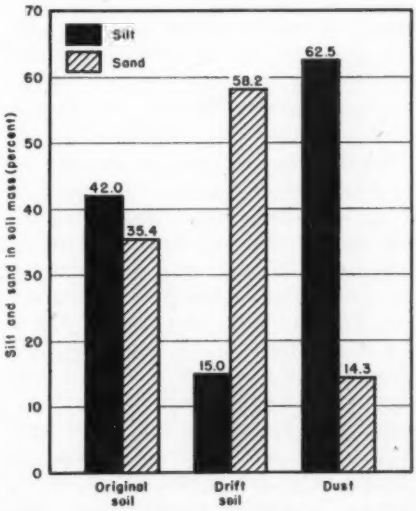

Fig. 3. Changes in silt and sand content of Richfield silt loam caused by the sifting and sorting action of wind in the erosion process.

the total fertility of the soil by sifting out the lighter and more fertile portion and carrying it away.

On sandy soils, such as those in much of the Plains country and certain other parts of the United States, approximately one-fourth of the soil mass is removed as dust beyond the boundaries of the eroding fields. The other three-fourths is drift material which accumulates against fences and other obstructions (2). On finer-textured soils a higher proportion is removed as dust.

Both the eroded fields and the drifts were more sandy than adjacent noneroded fields on soils derived from sandstone as a result of the Kansas storms (26). The original content of silt was reduced by about 65 per cent and the sand content was increased in like amount in the drifts on residual soils. These changes were brought about by only two or three windstorms. The storms changed the texture of the transported soil material from a loam to a sandy loam. Much of the silt, which apparently was not as well aggregated as in loess soils, was blown completely away, together with much of the organic matter which was held with it. The clay content remained about the same in the wind-blown portion as in the residual soil. The clay was held in close association with that of the drift material which was aggregated sufficiently to remain in the vicinity of the eroded area.

On the average, over 60 per cent of the total dust contained in that portion of the soil shifted by wind was carried away. Soils of noneroded fields contained 46.7 per cent silt, whereas the drifts from similar fields contained only 17.5 per cent silt. There was a loss of silt from the field equal to 29.2 per cent of the weight of the soil that was moved by the wind. It was estimated that 41 tons of silt and 4 tons of clay per acre were lost from the eroding fields as a result of these windstorms. It may be expected that soils containing large quantities of sand will become sandier with each windstorm.

It was estimated that the dust storm of May 12, 1934, moved 300,000,000 tons of soil from the Great Plains (2). More than 100 tons of dust fell per square mile in parts of the country affected by this storm, which covered a vast territory extending from the vicinity of the Rocky Mountains to several hundred miles over the Atlantic. It was reported that 85.8 tons of dust fell per square mile in Westphalia, Germany, during the dust storm of 1859, which was thought to have originated in the Sahara (11).

Wind Erosion Reduces Crop Yields

The loss of organic matter and lightweight particles of soil during the dust storms of the 1930's marked the beginning of serious inroads on the fertility reserves of the soils in the great dry-land winter-wheat belt of the Southern High Plains. Initial removal by wind of the rich topsoil in this area lowered crop yields 4.5 times as fast as did later removals of the surface and subsoil (8). Where land had been in cultivation about 30 years or so, and no effort had been made to control erosion, the loss in production averaged 7 bushels of wheat per acre (9). Of this 7-bushel loss in yielding capacity, 4.2 bushels were due to removal of fertility by erosion and 2.8 bushels due to the removal of fertility by crops grown on the land.

Removals by cropping progressed directly in relation to yields. But erosion damages reduced yields very rapidly during the first few years after erosion started. During these years the rich organic matter, silt, and clay were rapidly being removed from the topsoil.

Wind erosion reduced the productive capacity of High Plains wheatlands an average of 2.2 bushels per acre annually on land in continuous wheat culture and 4.29 bushels on land in summer fallow. Erosion reduced the yield 0.52 bushel per acre per year the first 4 years after the land began eroding, and at the rate of 0.11 bushel an-

Fig. 4. Organic matter, silt, and clay floated down from higher areas and formed a deposit several inches thick in this corn field.

nually for the next 21-year period. Serious erosion usually began 2 to 4 years after the land was first put in cultivation.

Water Erosion Is a Selective Process

Erosion caused by the combined action of raindrop and surface flow is a selective process. Not only are fine particles of surface litter removed, but the finer soil particles (which are relatively high in organic matter and plant nutrients) also tend to be removed (14) (Fig. 4). The loss of organic matter by erosion on fallow soil was 18 times as great as that normally lost by oxidation (23). The material removed by erosion contained about 200 times as many microorganisms as the original soil (25). This is because so much of the finer soil particles and organic material is usually washed off in comparison with the amount of coarse particles.

The selective feature of soil erosion is the major factor contributing to the rapid depletion of fertility and productivity of cultivated lands (18). The material eroded from a Collington sandy loam in New Jersey from June 12, 1938, to December 31, 1941, contained 4 times as much organic matter, 1.5 times as much phosphoric acid, 1.4 times as much potassium, and 2.3 times as much calcium as the original soil.

Likewise, material which eroded from a silt loam soil planted to corn in Indiana contained 2.3 times as much nitrogen as the surface 7 inches of the original soil (1). The total losses of solids from all crops in a rotation contained an average of 0.44 per cent nitrogen, or nearly 3 times as much as the surface soil. Material lost from land in hay contained approximately 9 times as much nitrogen as the original topsoil. The eroded material contained about twice as much organic matter as the topsoil.

With moderate erosion, such as that produced by light rains or under sod cover, the proportion of organic matter and fine soil particles in the soil removed is higher than with more severe erosion. As the rate of erosion increases in severity, the eroded materials tend to become similar in composition to the eroding soil (24). However, the aggregate fertility losses by slight erosion

may be more detrimental than those resulting from more severe erosion.

The organic matter lost by erosion varies in amount and character. The amount tends to be high in proportion to the total amount of soil that is removed.

Eroding surface soil in New Jersey contained an average of 15.8 per cent of particles less than 50 microns in diameter whereas the eroded material contained an average of 58 per cent of this size particle (19). The eroded material contained 4.7 times as much organic matter, 5 times as much nitrogen, 3.1 times as much phosphoric acid, and 1.4 times as much potassium as the field soil. The phosphoric acid in the eroded material was of the same availability as that of the eroding soil. The availability of potassium in the eroded material was 3.7 times greater than that left in the original soil.

During the 2-year period, Sept. 1, 1920, to Aug. 31, 1922, 207,849.6 pounds of soil per acre were lost by erosion from a plot in Missouri that had been spaded 4 inches deep and left fallow (7). This eroded soil contained 190.8 pounds of nitrogen and 90.94 pounds of phosphoric acid per acre. Measurements during the first year of this study showed that the eroded material contained 337.89 pounds of calcium and 69.61 pounds of sulfur.

Material which eroded from Dunmore silt loam with slopes ranging from 5 to 25 per cent in Virginia when cropped to corn was 11 and 16 per cent higher in total phosphoric acid and nitrogen, respectively, than the eroding soil (21). In one year 8.5 per cent of the soil's total supply of soluble phosphoric acid was removed by erosion. The eroded material contained 50 per cent more exchangeable basis than the eroding soil. The average annual loss of potassium exceeded 100 pounds per acre.

Erosion caused the loss of relatively much more clay than sand from Vernon fine sandy loam in Oklahoma when planted to sweet clover than when planted to cotton (15). The material which eroded from the cotton plot was more nearly similar in composition to the eroding soil. The material which eroded from the sweet clover land was much higher in silt and clay and lower in sand than the eroding soil.

The widest range between the composition of soil and eroded material is to be expected from loams and sandy loams while the narrowest is to be expected from silt and clay soils. Erosion of weakly aggregated or single-grained soils also may be expected to produce a product which varies widely in composition from the parent soil.

The sorting action of raindrops beating upon bare loams, sandy and sandy loam soils separates out the organic matter, silt, and clay from the sand. The organic matter, silt, and clay are then floated away by surface flow and the sand is left exposed at the surface (Fig. 5). This sand is turned under at the next plowing of the field or is mixed with the surface layer of the soil at the next cultivation. In either case a fresh supply of topsoil is brought to the surface for further action by raindrop splash. The repetition of this procedure over a period of years produces a sandier and less productive soil.

Erosion Prevents Accumulation of Organic Matter

It generally has been assumed that the difficulty experienced in building up or maintaining a high level of organic matter in the soil was due to rapid oxidation of this material. This was thought to be true especially in the South and other sections of the country where the average temperatures are high. However, more recent findings indicate that erosion and not oxidation is the major factor responsible for this condition.

The loss of organic matter by erosion on fallow soil in Iowa and Missouri was found to be 18 times as great as that normally lost by oxidation (23).

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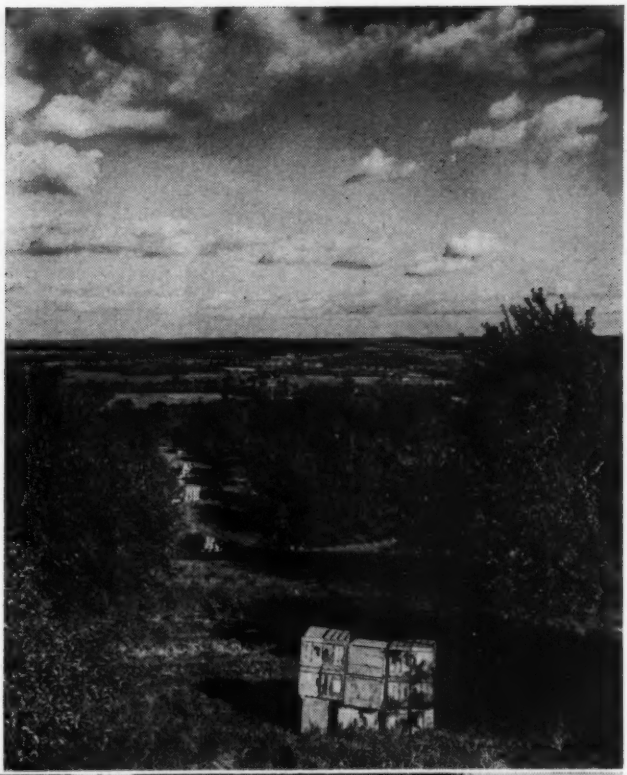
PICTORIAL

The Hunting Season Is Open!

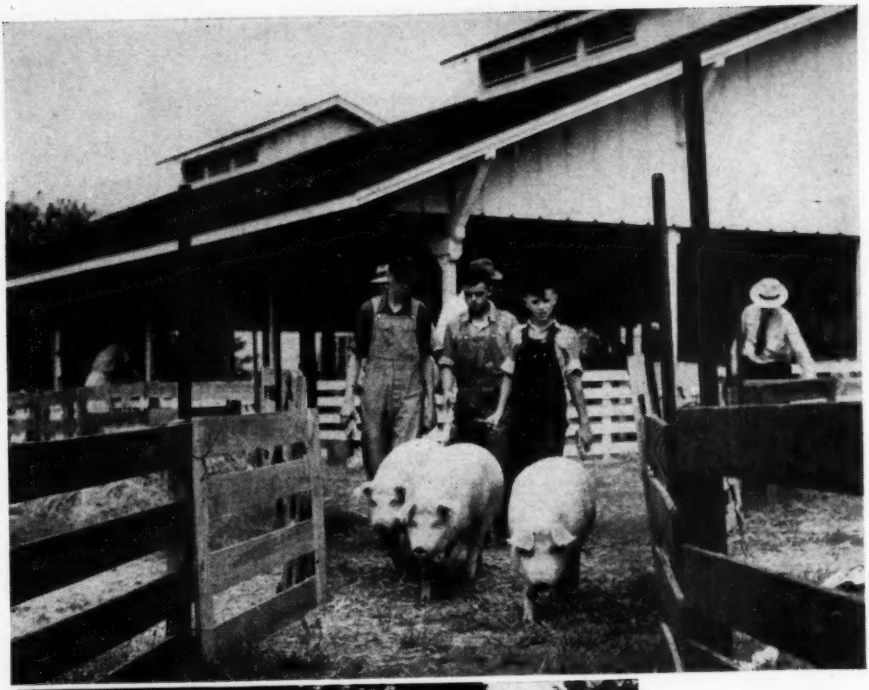
Corn in the Shock.

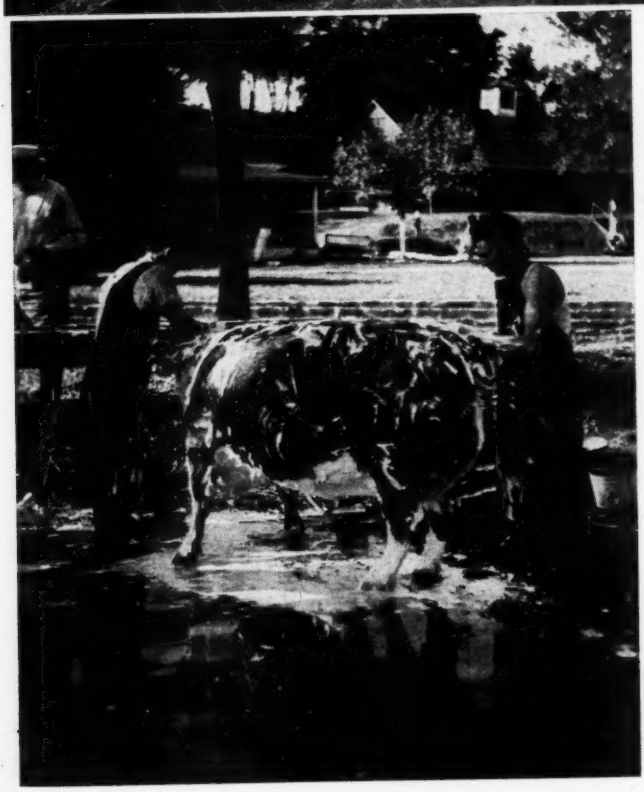
'Taters in the Bag.

Apples in the Box.



Cows Still on Grass.





Fair Time.

The Editors Talk

Rebuilding Strength in the Land

In his talk at the awards ceremony of Piedmont Communities Soil Conservation Contest, Spartanburg, South Carolina, on September 5, Secretary of Agriculture Charles F. Brannan gave a new definition of soil conservation. "The modern concept of conservation farming," he said, "has come to mean applying the necessary practices on a farm to increase production and to build up soil productivity, both at the same time. It means making soils yield abundantly year in and year out for an indefinite period. It means REBUILDING STRENGTH IN THE LAND."

Secretary Brannan pointed out that no longer do we consider soil conservation as limited to controlling erosion. We now know that soil deterioration through cropping also may be extremely serious. For soils subject to erosion it is often necessary to check cropping losses and increase fertility along with application of erosion control measures. We have also come to understand that conservation farming can seldom be achieved by a single practice. Instead, a combination of practices is usually needed, a combination fitted to the specific soil characteristics and needs. The basic physical objective of soil conservation activities by Department agencies is the use of each acre of agricultural land within its capabilities and the treatment of each acre of agricultural land in accordance with its needs for protection and improvement.

The occasion at which the Secretary was speaking marked the conclusion of a 2½-year contest among five soil conservation districts in the Piedmont. Nearly 1,500 farmers from six counties participated. Merchants, business firms, and industries contributed more than $25,000 worth of prizes. Since the districts were organized, these farmers have put more than 77 thousand acres in soil-building grasses and legumes. They have started rotating crops on 27 thousand acres, terraced nearly 20 thousand. They are strip-cropping 10½ thousand acres, farming 37 thousand on the contour, have planted trees on 4½ thousand acres, and are practicing better woodland management on a much larger area. Farm ponds, waterways, and plantings for wildlife have been made. These farmers have limed, fertilized, and planted cover crops, and have applied many other soil-conserving practices.

Undoubtedly the contest was an incentive for all this activity. People everywhere react to the competitive influence. However, it is safe to believe that the love of the land and the opportunities offered to learn how to rebuild its strength were the major factors. Rewards far beyond those received will be forthcoming for all concerned, and other sections of the country could well benefit by staging similar contests to rebuild the strength of their communities. As stated by the Secretary—American farmers generally face the job of bringing most of the land now in use to a high level of economic production on a sustained basis. The job is so big that it calls for full cooperation from everyone—farm-

ers, businessmen, consumers, church and civic organizations, state institutions, and federal agencies. Throughout the Nation we need the kind of cooperation that there was in the Piedmont in conducting their soil conservation contest.

The Jordan Fertility Plots

The annual meetings of the American Society of Agronomy and the Soil Science Society of America, held jointly at Pennsylvania State College the latter part of August, again afforded opportunity for exchange of ideas and presentation for world usage of the results of research. The importance of this group may not always be fully realized. These scientists are directly or indirectly concerned with the investigation of the all-important problems of the production of food, feed, and fiber. The geneticists and crop-breeders have performed wonders in developing varieties of crops with increased productivity, higher disease resistance, and improved quality. The soil scientists are constantly showing how the soil can be made to produce more and better crops without being depleted. Truly, the agronomists are serving humanity as well as their own country by their efforts to increase and improve the supply and quality of our specific needs for food and clothing.

Pennsylvania State College had much to attract the agronomists. In addition to the excellent facilities provided for the meetings, there were the grass turf plots of the experiment station and the work of the Northeastern Regional Pasture Research Laboratory of the U. S. Department of Agriculture, the corn-breeding plots, the weed-control experiments, soil conservation work, and the famous rose gardens.

Probably of most general interest and uniqueness to the agronomists were the Jordan fertility plots. The original idea for these plots was developed by Evan Pugh, the first President of Pennsylvania State College, who had worked with Lawes and Gilbert at the Rothamsted Experiment Station in England. The plots in their present form were laid out by Dr. Jordan in 1881 and thus are the oldest, continuous extensive fertility experiment in the United States. Originally, there were four tiers of plots so as to allow each crop of the four-year rotation to be grown each year. Unfortunately, the College authorities felt that space was needed for other purposes, and two of the tiers were sacrificed several years ago, leaving two tiers that now make up this world-famous experimental field.

Those who visited the plots during the agronomy meetings were much impressed with the great foresight shown by those who laid them out, in that the system of treatments even by present-day standards is of high quality. These plots have taught many valuable lessons in fertilizer usage. They offer still greater sources of material for investigations on soil fertility, soil chemistry, and soil physics. Contrast between soil in crops and continuous sod is shown by the strip between the plots.

The opportunity of studying the long-time effects of various soil treatments on the soil furnished by these plots is of incalculable value. The country has become very conscious of the necessity for conserving the great basic resource —the soil. Many wonder what certain types of treatment will do to a soil if continued over a long period of time, and many controversies have arisen over various phases of this subject. The answers to many of these questions in all probability can be found in the Jordan fertility plots.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1925.....	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926.....	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927.....	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928.....	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929.....	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930.....	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931.....	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932.....	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	78.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941.....	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942.....	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945.....	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947.....	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948.....	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949.....	28.6	46.3	128.0	214.0	119.0	186.0	16.55	43.40	....
1950									
September...	39.98	55.4	105.0	192.0	144.0	194.0	15.55	78.80	....
October.....	38.90	55.1	85.8	154.0	137.0	191.0	15.85	81.50	....
November....	41.13	52.5	87.8	148.0	137.0	194.0	16.45	98.40	....
December....	40.36	47.2	88.9	173.0	145.0	203.0	17.05	102.00	....
1951									
January.....	41.31	45.9	98.6	194.0	154.0	209.0	17.85	101.00	....
February....	41.75	32.5	103.0	205.0	160.0	221.0	18.45	100.00	....
March.....	42.73	26.6	107.0	207.0	160.0	212.0	18.35	103.00	....
April.....	43.17	25.3	112.0	203.0	162.0	214.0	18.35	103.00	....
May.....	42.45	39.8	109.0	209.0	164.0	211.0	18.15	101.00	....
June.....	42.02	49.0	108.0	210.0	162.0	208.0	16.85	95.60	....
July.....	39 11	49.5	118.0	219.0	163.0	205.0	15.45	78.00	....
August.....	34.60	47.7	117.0	273.0	165.0	205.0	15.65	69.10	.. .
Index Numbers (Aug. 1909—July 1914 = 100)									
1925.....	158	168	245	188	109	163	108	140	143
1926.....	101	179	189	134	116	138	112	98	139
1927.....	163	207	146	124	132	135	87	154	127
1928.....	145	200	76	134	131	113	95	152	154
1929.....	135	183	189	133	124	117	92	137	137
1930.....	77	128	131	123	93	76	93	98	129
1931.....	46	82	66	83	50	44	73	40	115
1932.....	52	105	55	62	50	43	52	46	102
1933.....	82	130	118	79	81	84	68	57	91
1934.....	100	213	64	91	127	96	111	146	95
1935.....	90	184	85	80	102	94	63	135	119
1936.....	100	236	164	106	163	116	94	148	104
1937.....	68	204	76	89	81	109	74	87	110
1938.....	69	196	80	79	76	64	57	97	88
1939.....	73	154	100	84	88	78	67	94	91
1940.....	80	160	78	97	96	77	64	96	111
1941.....	137	264	116	105	117	107	82	211	129
1942.....	153	369	168	134	143	124	91	202	163
1943.....	160	405	188	235	174	154	125	231	245
1944.....	167	420	214	216	170	160	139	234	213
1945.....	181	366	205	232	198	170	127	227	207
1946.....	263	382	178	248	212	209	141	319	182
1947.....	257	380	232	248	336	259	148	381	226
1948.....	245	482	222	253	201	226	155	298	214
1949.....	231	463	184	244	210	210	139	192	201
1950									
September...	322	554	151	219	224	219	131	349	126
October.....	314	551	123	175	213	216	134	361	138
November....	332	525	126	169	213	219	139	436	188
December....	325	472	128	197	226	230	144	452	211
1951									
January.....	333	459	141	221	240	236	150	448	324
February....	337	325	148	233	249	250	155	443	333
March.....	345	266	154	236	249	240	155	457	265
April.....	348	253	161	231	252	242	155	457	225
May.....	342	398	156	238	255	239	153	448	239
June.....	339	490	155	239	252	235	142	424	189
July.....	315	495	169	249	254	232	130	346	204
August.....	279	477	168	311	257	232	132	306	181

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per Unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per Unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950						
September	3.00	1.71	11.44	10.85	10.85	10.32
October	3.00	1.71	11.86	10.63	10.62	10.32
November	3.00	1.68	11.96	10.63	10.85	10.62
December	3.00	1.88	13.48	10.95	10.93	10.93
1951						
January	3.10	1.88	13.37	11.30	11.29	11.11
February	3.13	1.88	13.58	11.39	11.53	11.30
March	3.13	1.88	13.56	11.41	11.53	11.53
April	3.13	1.88	13.61	11.50	11.17	11.35
May	3.13	1.88	13.84	10.41	10.09	10.25
June	3.13	1.88	13.53	9.98	8.87	8.50
July	3.13	2.03	12.37	10 06	8.68	8.56
August	3.13	2.07	11.94	10.41	8.66	8.66
	Index Numbers (1910-14 = 100)					
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	112	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950						
September	112	60	327	307	322	293
October	112	60	339	301	315	293
November	112	59	342	301	322	302
December	112	66	385	310	324	311
1951						
January	116	66	382	320	335	316
February	117	66	388	323	342	321
March	117	66	388	323	342	328
April	117	66	389	326	331	322
May	117	66	395	295	299	291
June	117	66	387	283	263	241
July	117	71	353	285	258	243
August	117	73	341	295	257	246

Wholesale Prices of Phosphates and Potash * *

	Superphosphate, Baltimore, per unit	Florida land pebble, 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports[1]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[1]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[1]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1925	.600	2.44	6.16	.584	.860	23.72	.483
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950							
September	.760	3.81	5.47	.368	.704	13.98	.193
October	.760	3.98	5.47	.386	.704	13.98	.193
November	.760	3.98	5.47	.386	.732	14.72	.193
December	.798	3.98	5.47	.420	.796	16.00	.210
1951							
January	.810	3.98	5.47	.420	.796	16.00	.210
February	.810	3.98	5.47	.420	.796	16.00	.210
March	.810	3.98	5.47	.420	.796	16.00	.210
April	.810	3.98	5.47	.420	.796	16.00	.210
May	.810	3.98	5.47	.420	.796	16.00	.210
June	.810	3.98	5.47	.355	.708	13.44	.176
July	.810	3.98	5.47	.389	.768	14.72	.193
August	.810	3.98	5.47	.389	.768	14.72	.193
Index Numbers (1910-14 = 100)							
1925	110	68	126	82	90	98	74
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950							
September	142	106	112	67	74	58	82
October	142	110	112	70	74	58	82
November	142	110	112	70	77	61	82
December	149	110	112	75	84	66	85
1951							
January	151	110	112	75	84	66	85
February	151	110	112	75	84	66	85
March	151	110	112	75	84	66	85
April	151	110	112	75	84	66	85
May	151	110	112	75	84	66	85
June	151	110	112	65	74	56	80
July	151	110	112	70	81	61	82
August	151	110	112	70	81	61	82

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1925.....	156	153	151	112	100	131	109	80
1926.....	146	150	146	119	94	135	112	86
1927.....	141	148	139	116	89	150	100	94
1928.....	149	152	141	121	87	177	108	97
1929.....	148	150	139	114	79	146	114	97
1930.....	125	140	126	105	72	131	101	99
1931.....	87	119	107	83	62	83	90	99
1932.....	65	102	95	71	46	48	85	99
1933.....	70	104	96	70	45	71	81	95
1934.....	90	118	109	72	47	90	91	72
1935.....	109	123	117	70	45	97	92	63
1936.....	114	123	118	73	47	107	89	69
1937.....	122	130	126	81	50	129	95	75
1938.....	97	122	115	78	52	101	92	77
1939.....	95	121	112	79	51	119	89	77
1940.....	100	122	115	80	52	114	96	77
1941.....	123	130	127	86	56	130	102	77
1942.....	158	149	144	93	57	161	112	77
1943.....	192	165	151	94	57	160	117	77
1944.....	196	174	152	96	57	174	120	76
1945.....	206	180	154	97	57	175	121	76
1946.....	234	197	177	107	62	240	125	75
1947.....	275	231	222	130	74	362	139	72
1948.....	285	250	241	134	89	314	143	70
1949.....	249	240	226	137	99	319	144	70
1950								
September.	272	252	247	131	85	324	142	70
October...	268	253	247	131	85	323	142	73
November.	276	255	251	132	85	328	142	74
December..	286	257	256	138	88	346	149	78
1951								
January...	300	262	261	140	90	351	151	78
February..	313	267	268	141	91	358	151	78
March....	311	272	269	142	91	357	151	78
April.....	309	273	268	141	91	353	151	78
May.....	305	272	266	139	91	334	151	78
June.....	301	272	265	134	91	311	151	69
July.....	294	271	261	135	93	297	151	74
August....	292	271	258	135	94	294	151	74

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] All potash salts now quoted F.O.B. mines only: manure salts since June 1941, other carriers since June 1947.

**** The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. The maximum discount is now 16%. Applied to muriate of potash, a price slightly above $.353 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Fertilizers for Alaska 1951," Agr. Exp. Sta., Univ. of Alaska, Palmer, Alaska, Cir. 13, Jan. 1951, A. H. Mick, H. J. Hodgson and S. C. Litzenberger.

"Gypsum and Other Sulfur Materials for Soil Conditioning," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif., Cir. 403, Mar. 1951, D. G. Aldrich, Jr. and W. R. Schoonover.

"Fertilizing Materials 1950," Bur. of Chem., Dept. of Agr., Sacramento, Calif., Spec. Pub. No. 239, Mar. 1951.

"Poultry Manure, Its Nature, Care and Use," Agr. Exp. Sta., Univ. of Conn., Storrs, Conn., Bul. 272, Dec. 1950, S. Papanos and B. A. Brown.

"Fertilizer Analysis—Spring 1951," State Board of Agr., Control Div., Topeka Kan., July 1951.

"Fertilizer Recommendations for Tomatoes in Maryland," Ext. Serv., Univ. of Md., College Park, Md., Fact Sheet 2, Feb. 1951, F. C. Stark.

"Anhydrous Ammonia, A Good Nitrogen Fertilizer," E. C. 193; "Which Nitrogen Fertilizer Shall I Use?" E. C. 194; "What Is Liquid Fertilizer?" E. C. 195; Ext. Serv., Univ. of Nebr., Lincoln, Nebr., 1951, M. D. Weldon and W. E. Ringler.

"Fertilizer Possibilities in North Dakota," Cir. A-141, Jan. 1950; "Suggestions for Fertilizer Use in North Dakota," Cir. A-142, Jan. 1950; "Fertilizers for North Dakota Gardens and Lawns," Cir. A-152, Jan. 1951, H. A. Graves; Ext. Serv., Univ. of N. D., Fargo, N. D.

"Fertilizers for Greener Hills," Ext. Serv., W. Va. Univ., Morgantown, W. Va., Misc. Pub. No. 8, Apr. 1951.

"Fertilizer Use and Crop Yields in the Southern Region," Rpt. No. 1, July 1951; "Fertilizer Use and Crop Yields in the North Central Region," Rpt. No. 2, July 1951; "Fertilizer Use and Crop Yields in the Northeastern Region," Rpt. No. 3, Aug. 1951; Natl. Soil and Fert. Res. Comm., USDA, Wash., D. C.

Soils

"Conservation of Michigan's Muck Soil," Ext. Serv., Mich. State College, East Lansing, Mich., Ext. Bul. 307, Apr. 1951, P. M. Harmer.

"Soil Improvement and Conservation in Missouri," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Cir. 357, Mar. 1951, M. F. Miller.

"100 Questions and Answers on Liming Land," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Bul. 754, Mar. 1951.

"Fertility Status of North Carolina Soils," Dept. of Agr., Raleigh, N. C., July 1951, C. D. Welch and W. L. Nelson.

"Wisconsin Tobacco Soils, Their Fertility and Management," Agr. Exp. Sta., Univ. of Wis., Madison, Wis., Bul. 493, Apr. 1951, W. B. Ogden.

"Erosion Controlled by Terraces," Agr. Exp. Sta., Univ. of Wis., Madison, Wis., Bul. 494, June 1951, H. B. Atkinson and O. E. Hays.

"Water—Life for the Land," Agr. Exp. Sta., Univ. of Wy., Laramie, Wy., Cir. 39, Nov. 1950, B. R. Tomlinson and G. O. Woodward.

"Soil Survey, Newaygo County, Michigan," Agr. Exp. Sta., Univ. of Mich., East Lansing, Mich., Series 1939, No. 9, Apr. 1951, A. H. Mick, R. M. Basile, A. W. Gronlund, J. T. Stone, C. L. Bennett, C. H. Wonser, and M. M. Striker.

"Soil Survey, Clallam County, Washington," Agr. Exp. Sta., Univ. of Wash., Pullman, Wash., Series 1938, No. 30, Apr. 1951, L. H. Smith, H. A. Olsen, and W. W. Fox.

"Border Irrigation," USDA, Wash., D. C., Leaf. No. 297, May 1951, E. J. Core.

Crops

"Effect of Slash Mulch and Slash Burn on Pine and Spruce Plantings," Agr. Exp. Sta., New Haven, Conn., Bul. 548, Apr. 1951, H. A. Lunt.

"Research Work at the Illinois Agricultural Experiment Station, Report for 1948-1950," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Feb. 1951.

"Thirty-third Annual Report of the Department of Agriculture for the Fiscal Year Beginning July 1, 1949, and Ending June 30, 1950," Dept. of Agr., Springfield, Ill.

"1950 Illinois Tests of Corn Hybrids in Wide Use." Agr. Exp. Sta., Univ. of Ill.,

Urbana, Ill., Bul. 544, Feb. 1951, J. W. Pendleton, G. H. Dungan, B. Koehler, J. H. Bigger, A. L. Lang, R. W. Jugenheimer, and G. E. McKibben.

"Joliet Soil Experiment Field 1914-1950, General Summary of Results," AG-834, F. C. Bauer, A. L. Lang, and D. A. Vinson; "Brownstown Soil Experiment Field 1940-50, General Summary of Results," AG-953, F. C. Bauer and P. E. Johnson; "Toledo Soil Experiment Field 1913-1950, General Summary of Results," AG-1023, F. C. Bauer and P. E. Johnson; Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., 1951.

"Hoosier Gold Sweet Corn," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Sta. Bul. 563, Apr. 1951, G. M. Smith.

"Environment and Kansas Wheat Varieties," Agr. Exp. Sta., Kans. State College, Manhattan, Kans., Cir. 270, Dec. 1950, J. A. Shellenberger, J. A. Johnson, H. H. Laude, and G. D. Miller.

"Potato Growing," Ext. Serv., Univ. of Ky., Lexington, Ky., Cir. 307, Rev. Jan. 1951, J. S. Gardner.

"Planting Forest Trees in Maine," Ext. Bul. 410, Mar. 1951, L. P. Bissell; "Growing Your Own Vegetables," Ext. Bul. 411, May 1951; Ext. Serv., Univ. of Me., Orono, Me.

"Annual Report for the Fiscal Year Ending June 30, 1950," Agr. Exp. Sta., Univ. of Mass., Amherst, Mass., Bul. 459, Sept. 1950.

"Maryland Vegetable Varieties for 1951 for Planting and Freezing," Ext. Serv., Univ. of Md., College Park, Md., Fact Sheet 1, Feb. 1951, E. K. Bender.

"Fruit Varieties for Minnesota," Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Bul. 224, Rev. June 1951, L. C. Snyder, W. H. Alderman, and W. G. Brierley.

"Vegetable Varieties for Minnesota," Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Fldr. 154, Feb. 1951, O. C. Turnquist.

"Some Factors Influencing Pod Set and Yield of the Lima Bean," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Res. Bul. 466, Nov. 1950, V. N. Lambeth.

"Corn Hybrids Adapted for Missouri," Bul. 546, Feb. 1951, M. S. Zuber and C. O. Grogan; "Good Pastures Pay," Bul. 547, Feb. 1951, E. M. Brown; "Potato Growing in Missouri, Bul. 548, Mar. 1951, V. N. Lambeth; Agr. Exp. Sta., Univ. of Mo., Columbia, Mo.

"Profitable Tomato Production," Ext. Serv., Univ. of Mo., Columbia, Mo., Cir. 598, May 1951, C. R. Cunningham and V. N. Lambeth.

"Important Grasses on Montana Ranges," Agr. Exp. Sta., Mont. State College, Bozeman, Mont., Bul. 470, Dec. 1950, H. E. Morris, W. E. Booth, G. F. Payne, and R. E. Stitt.

"Chrysanthemum Culture in Nebraska," Ext. Serv., Univ. of Nebr., Lincoln, Nebr., E. C. 1273, G. Viehmeyer and W. C. Whitney.

"Crop Varieties in Nebraska," Ext. Serv., Univ. of Nebr., Lincoln, Nebr., E. C. 100 (Rev.), Feb. 1951, H. H. Wolfe and J. D. Furrer.

"Thirty-fourth Annual Report of the New Jersey State Department of Agriculture, July 1, 1948-June 30, 1949," Dept. of Agr., Trenton, N. J., June 30, 1949.

"A Comparison of Methods for Seeding Bromegrass," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Bul. 755, Mar. 1951, G. H. Ahlgren, W. W. Washko and G. K. McCutcheon.

"The 1951 New Jersey Green Pasture-Forage Program," Ext. Serv., Rutgers Univ., New Brunswick, N. J., Leaf. 49, Mar. 1951, J. E. Baylor.

"The Planting and Care of Shrubs and Trees," Bul. 185, Rev. Mar. 1951, D. J. Bushey; "1951 Hay and Pasture Seedings," Bul. 781, Rev. Jan. 1951; "Sweet Corn," Bul. 819, Mar. 1951, C. B. Raymond and R. D. Sweet; "Planning and Planting the Home Garden," Bul. 820, Feb. 1951, C. B. Raymond, E. G. Fisher, and L. H. MacDaniels; "Vegetable Breeders Offer New Varieties for 1951," Bul. 827, Feb. 1951, Paul Work, G. O. Elle, and J. A. Cook; Ext. Serv., Cornell Univ., Ithaca, N. Y.

"Research and Farming," Agr. Exp. Sta., Univ. of N. C., Raleigh, N. C., P. R. No. 4, 72nd A. R., Vol. VIII, Spring 1950.

"Small Fruits for the Home Garden," Ext. Serv., Okla. A. & M. College, Stillwater, Okla., Cir. 432, E. L. Whitehead.

"Recommended Pacific Northwest Wheat Varieties," Ext. Serv., Univ. of Idaho, Moscow, Idaho, State College of Wash., Pullman, Wash., Oreg. State College, Corvallis, Oreg., P. N. W. Bul. 4, May 1951.

"Holly Production in Oregon," Agr. Exp. Sta., Oreg. State College, Corvallis, Oreg., Sta. Bul. 455, July 1948, A. N. Roberts and C. A. Boller.

"Fourteenth Annual Report of Pasture Research in the Northeastern United States," U. S. Reg. Pasture Res. Lab., State College, Pa., 1950.

"Quanah Wheat," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Bul. 734, May 1951, I. M. Atkins.

"Bermudagrass Research in Texas," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Cir. 129, Apr. 1951, E. C. Holt, R. C. Potts, and J. F. Fudge.

"Crops for Silage and Forage at Mt. Pleasant, 1950," P. R. 1344, Mar. 22, 1951, M. Buckingham and R. C. Potts; "Castor Beans as a Crop in the Northern Rolling Plains Area," P. R. 1354, Apr. 6, 1951, J. R. Quinby and D. L. Van Horn; "Crops for Silage and Forage at Nacogdoches, 1949-50," P. R. 1358, Apr. 10, 1951, H. C. Hutson and R. C. Potts; "Cabbage Variety Trials in the Lower Rio Grande Valley, 1950-51," P. R. 1361, Apr. 14, 1951, P. W. Leeper and C. A. Burleson;

"Tomato Variety Trials in the El Paso Valley, 1950," P. R. 1365, Apr. 21, 1951, M. D. Bryant and P. J. Lyerly; "Denton Cotton Variety Tests, 1946-50," P. R. 1366, Apr. 23, 1951, J. H. Gardenhire and D. I. Dudley; Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex.

"How to Feed a Tree," Ext. Serv., Univ. of Vt., Burlington, Vt., Brieflet 862, P. R. 651, E. P. Hume.

"Growing Cauliflower," Misc. Pub. No. 3, Jan. 1951; "Growing Broccoli," Misc. Pub. No. 4, Jan. 1951; "Growing Tomatoes," Misc. Pub. No. 5, Apr. 1951 (Reprint); C. R. Kemper and C. F. Bishop; "Growing Potatoes," Misc. Pub. No. 6, Jan. 1951; "Sweet Corn Production," Misc. Pub. No. 7, Jan. 1951; Ext. Serv., W. Va., Univ., Morgantown, W. Va.

"Growing Canning Peas in Wisconsin," Agr. Exp. Sta., Univ. of Wis., Madison, Wis., Bul. 444, May 1939 (Rev. Feb. 1951), D. J. Hagedorn.

"Agricultural Extension in Wisconsin, Report for 1950," Cir. 398, June 1951; "Meet Summer Pasture Shortages with Sudan Grass," Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 399, May 1951, H. L. Ahlgren and D. C. Smith.

"Sixtieth Annual Report of the Wyoming Agricultural Experiment Station 1949-50," Agr. Exp. Sta., Univ. of Wy., Laramie, Wy.

"Crops in Peace and War, The Yearbook of Agriculture 1950-1951," USDA, Wash., D. C.

"Report on the Agricultural Experiment Stations, 1950," USDA, Wash., D. C., Jan. 1951, R. W. Trullinger.

"Growing Vegetables in Town and City," USDA, Wash., D. C., Bul. No. 7, Apr. 1951, V. R. Boswell and R. E. Wester.

"Six Long Strides to Better Sandy Soils, 1. Grow More Legumes," Spec. Cir., Jan. 1951; "Six Long Strides to Better Sandy Soils, 2. Lime the Soil as Needed," Spec. Cir.; Ext. Serv., Univ. of Wis., Madison, Wis., A. R. Albert.

Economics

"Annual Report of the Statistics Branch 1950," Dept. of Agr., Toronto, Ont., Canada, Sessional Paper No. 22, 1951.

"What Determines Soybean Prices," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Bul. 546, Mar. 1951, G. L. Jordan.

"The Short Time Response of Agricultural Production to Price and Other Factors," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Sta. Bul. 555, Oct. 1950, R. L. Kohls and D. Paarlberg.

"Buying of Farms in Story County, Iowa, 1940-48," Agr. Exp. Sta., Iowa State College, Ames, Iowa, Res. Bul. 377, Dec. 1950, V. L. Hurlburt.

"Adjust Your Farm Program to the Fifties through Balanced Farming," Ext. Pub. 1078, Oct. 1950; "Louisiana Farm and Home Situation for 1951," Ext. Pub. 1082, Dec. 1950; Ext. Serv., La. State Univ., Baton Rouge, La.

"Maine Facts," Ext. Serv., Univ. of Me., Orono, Me., Misc. Pub. No. 619 and Ext. Bul. No. 412, June 1951.

"Maryland's Sweet Potato Industry," Ext. Serv., Univ. of Md., College Park, Md., Fact Sheet 3, Feb. 1951, H. L. Stier.

"Father-Son Farm Agreements," Ext. Serv., N. C. State College, Raleigh, N. C., Southern Farm Mgmt. Ext. Pub. No. 1.

"Significance of Quality Loss in Marketing Early Idaho-Oregon Potatoes," Agr. Exp. Sta., Oreg. State College, Corvallis, Oreg., Sta. Bul. 495, Jan. 1951.

"A Study of Attitudes of Utah Farm People Toward the Cooperative Extension Service," Ext. Serv., Utah State College, Logan, Utah, Ext. Bul. 209, S. L. Brower and R. W. Roskelley.

"Better Rural Living," Ext. Serv., W. Va. Univ., Morgantown, W. Va., Cir. 359, Dec. 1950.

"Marketing Potatoes in Wisconsin," Agr. Exp. Sta., Univ. of Wis., Madison, Wis., Res. Bul. 173, Apr. 1951, H. H. Bakken and W. S. Rowan.

"A Dozen Years of Conservation Farming," Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 401, June 1951, H. O. Anderson and P. E. McNall.

"The Agricultural Production Job," USDA, Wash., D. C., July 1951.

"A Survey of Soviet Russian Agriculture," USDA, Wash., D. C., Mono. 5, L. Volin.

"You Owe the Land a Living," Forest Serv., USDA, Wash., D. C., S. Ewing.

"Economic Aspects of Transportation Affecting a Cooperative Fertilizer Program in the North Central States," Farm Cr. Adm., USDA, Wash., D. C., Misc. Rpt. 149, May 1951, C. L. Scroggs.

A friend spent the night with a farmer. The next morning he appeared downstairs with a black eye.

"How did you get that?" asked the farmer in surprise.

"Oh, I just happened to fall in the guest chamber, that's all," answered the visitor.

"Gee! you didn't break it, did you?" anxiously inquired the farmer.

Jimmy and Pete always walked to school together. One morning Pete showed up without Jimmy. Then a neighbor phoned that Jimmy had been found unconscious where he had slipped and fallen on the ice.

"Why didn't you get help when Jimmy fell, Pete?" asked teacher.

"We were late for school," replied Pete. "And anyhow, I thought he was dead."

Fertilizers for Vegetable Crops . . .

(*From page* 16)

aration, planting, cultivation, and harvesting, high yields are absolutely necessary if the grower is to remain in business. In the case of Blue Lake beans, it is generally accepted that a yield of six tons per acre is the "breaking point." In other words, the grower only begins to make a return on his investment after he has harvested six tons of beans from each acre.

Growers and processors have learned that not all soils are good bean soils or broccoli soils. They have learned also that even though the annual rainfall in the area ranges from 35 to 50 inches, supplemental irrigation is essential for high yields and good quality. So intent on this matter of quality are most processors that contracts for beans and certain other crops are not taken from growers unless they have irrigation facilities available. Irrigation, incidentally, is done almost entirely by use of portable sprinkling systems.

Grower "know-how" includes the help of fieldmen from the various processors. These fieldmen are in constant touch with new developments being made by the experiment stations and those in industry supplying seeds, fertilizers, fungicides, insecticides, machinery, etc. used in the production of the crops. The grower and fieldman "know-how" includes a knowledge of proper varieties, fertilizer requirements, planting dates, seeding rates, insect and disease control, irrigation, and harvesting methods.

A good climate, grower "know-how," and responsive soils have paved the way for the use of ever-increasing quantities of commercial fertilizers. Until about 10 years ago the amount and kind of fertilizer used and the manner in which it was applied varied from grower to grower. The work of the Western Washington and the Southwest Washington experiment

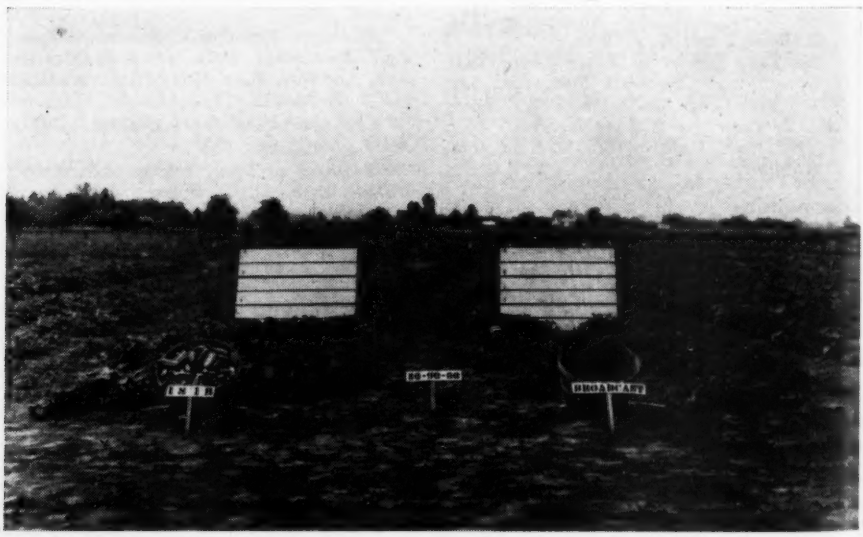


Fig. 6. When fertilizer was banded one inch to the side of and one inch below the seed, the yield of cucumbers was greatly increased over the treatment in which the fertilizer was broadcast and disced into the soil.

stations has tended to standardize fertilizer practices. Workers from these stations conducted field trials throughout the area and have made the resulting information available to all concerned. The results of these trials, a few of which are reported in the following paragraphs, brought about a sharp increase in the rate of fertilizer application, changes in methods of application, and the kind or ratios of fertilizer used.

The results of a number of studies on the effect of fertilizer rates, ratios, and placement on yield of vegetables in western Washington are discussed in the following paragraphs.

Fertilizer Ratios

Fertilizer ratios are the proportions or ratios of nitrogen, phosphoric acid, and potash to each other as contained in a sack or ton of complete fertilizer. With few exceptions vegetables grown in western Washington respond best to complete fertilizers. One of these exceptions is canning peas, which respond well to phosphates and potash but not to nitrogen. In fact, the results of numerous trials by the experiment station show that the addition of nitrogen to the phosphate-potash mix often depressed the yield. There are a few soils, such as the Felida silt loam in the southwest part of the State, in which the response to potash on nearly all crops is quite erratic.

Table I lists results which clearly show the effect of the omission of any of the three important nutrients on the yield of crops on certain soils. The Buckley loam, a soil high in organic matter, is particularly responsive to phosphorus and potash. The preliminary studies on the fertilizer requirements of this soil reported here indicate that a good fertilizer for cucumbers and potatoes on the Buckley soil should be rather low in nitrogen but relatively high in phosphorus and potash. A glance at the column "Increase over check" in Table I clearly indicates the importance of fertilizers in the production of high yields of crops. Important information not given in the table is the effect of fertilizers on the quality of the crop. Generally speaking, the more rapid the growth and the higher

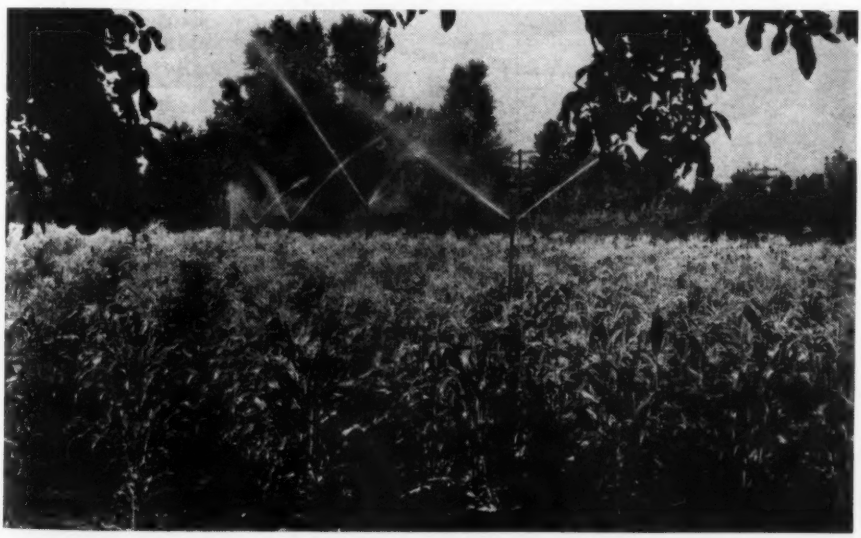


Fig. 7. Much of the irrigation in western Washington is by sprinkler. Supplementary fertilizer applications are often made through the sprinkler system.

TABLE I.—EFFECT OF FERTILIZER RATIOS ON YIELDS OF VEGETABLE CROPS

Crop and Soil	Fertilizer Pounds plant nutrients per acre			Yield lbs/A	Increase lbs/A over check	Value of increase less fertilizer & added harvest costs
	N	P_2O_5	K_2O			
Cucumbers	30	90	120	34,583	27,405	$251.55
	30	90	60	32,263	25,085	231.95
	30	60	60	31,465	24,287	227.27
	0	90	60	31,030	23,852	225.02
Buckley loam	60	90	60	30,450	23,272	208.42
	30	90	0	18,270	11,092	94.70
	30	0	60	9,425	2,247	13.47
	0	0	0	7,178	0	0
	0	60	120	4,110	1,267	49.55
Peas	0	60	90	4,045	1,202	48.10
	15	60	60	3,863	1,020	38.10
	0	60	60	3,859	1,016	40.60
Chehalis	30	60	60	3,556	713	20.05
silty clay	0	60	0	3,299	456	16.20
loam	15	0	60	3,010	167	2.05
	0	0	60	2,903	60	−.60
	0	0	0	2,843	0	0
	75	150	150	41,791	20,486	166.21
Potatoes	150	150	150	41,177	19,872	146.92
	75	150	225+Mg	40,870	19,565	152.50
	75	150	225	39,845	18,540	142.25
	75	225	150	39,128	17,823	131.33
Sultan	75	150	150 (K_2SO_4)	38,923	17,618	137.53
silt loam	75	150	75	38,411	17,106	136.91
	75	75	150	36,977	15,672	126.32
	37.5	150	150	36,772	15,467	122.57
	75	150	225 (K_2SO_4)	33,392	12,087	77.72
	75	0	150	29,500	8,195	59.80
	0	150	150	26,325	5,020	24.70
	0	0	0	21,305	0	0
	75	150	225	25,239	12,474	81.59
Potatoes	75	225	150	24,890	12,125	74.35
	75	150	150	23,086	10,321	64.56
Buckley loam	75	0	150	17,926	5,161	29.46
	75	150	0	16,548	3,783	8.18
	0	150	150	16,296	3,531	9.81
	0	0	0	12,765	0	0
	90	90	60	20,134	9,196	338.14
Pole Beans	60	90	60	19,360	8,422	312.58
	30	90	60	18,973	8,035	302.50
	30	90	0	17,424	6,486	244.14
	30	60	60	17,140	6,202	232.48
	30	90	120+Mg	16,650	5,712	205.98
Sultan silt	30	30	60	16,553	5,615	212.30
loam	30	90	120	16,166	5,228	186.62
	0	90	60	13,358	2,420	83.30
	0	0	0	10,938	0	0
	30	0	60	9,002	−1,936	−86.44

the yield, the better the quality of vegetables produced.

Fertilizer Rates

The question of how much fertilizer to use is one that confronts all growers. In Table II are presented some of the data accumulated by the stations in an effort to answer this question. The actual rate per acre giving the best results will depend on the ratio of the fertilizer used. The fertilizer must be applied at rates high enough to supply the maximum quantity of each element required by the crop for its best development on the soil on which it is grown. It can readily be seen that fertilizer rate and ratio studies must be conducted simultaneously in order to obtain the needed information. Substantial increases in yield are again recorded (Table II) from the use of commercial fertilizers.

A study of the data indicates that

TABLE II.—EFFECT OF RATE OF FERTILIZER APPLICATIONS ON YIELDS OF VEGETABLE CROPS IN WESTERN WASHINGTON

Crop and Soil	Fertilizer		Yield lbs/A	Increase lbs/A over check	Dollar Value of increase less fertilizer & added harvest costs [1]
	Kind	lbs/A			
Broccoli	15–10–10	0	4,840	0	
		300	6,292	1,452	$ 58.40
Sultan		600	8,107	3,267	134.95
silt loam		1,200	8,954	4,114	148.90
Cabbage	15–10–10	0	63,307	0	
		300	68,341	5,034	23.55
Sultan		600	75,214	11,907	60.90
silt loam		1,200	81,990	18,683	83.32
Cauliflower	10–10–10	0	5,905	0	
		300	11,500	5,595	129.37
Sultan		600	12,700	6,795	148.87
silt loam		900	14,075	8,170	172.75
Cucumbers	10–20–20	0	16,208	0	
(for pickling)		300	26,411	10,203	86.43
		450	27,042	10,834	84.94
Sultan silt loam		600	30,210	14,002	108.82
Pole Beans	5–15–10	0	14,423	0	
		500	18,973	4,550	160.00
Sultan silt loam		750	20,715	6,292	218.68
Potatoes	10–20–20	0	25,300	0	
		500	41,996	16,696	140.96
Sultan		750	37,899	12,599	86.99
silt loam		1,500	49,576	24,276	164.76
		2,000	54,902	29,602	192.02
Sweet Corn	5–20–10	0	7,422	0	
		250	7,944	522	−4.03
Sultan		500	10,076	2,654	8.04
silt loam		1,000	10,722	3,300	−4.00

[1] Values per pound paid by processors—4-year average: Broccoli—6 cents; Cabbage—¾ cent; Cauliflower—2½ cents; Cucumbers—2 cents; Pole Beans—6 cents; Potatoes—1 cent; Sweet Corn—1¼ cents.

even higher rates should be used in future studies. It will be noted that rather marked increases in yield were obtained between the treatments receiving the highest and next highest rates of application. It is apparent that as more information is developed as to the proper fertilizer rates and ratios to use and on methods of application, the quantity of fertilizer that can be effectively used for vegetable production will continue to increase.

Fertilizer Placement

Not only must the grower use fertilizer of the right ratio applied at adequate quantities per acre, but he must also consider the manner in which it is to be applied. The importance of the method of application is indicated by the data presented in Table III. In each case the results were much better from the band-applied fertilizer than when the same materials were broadcast and worked into the soil. Planters which will place the fertilizer for some crops are now available. Western Washington growers have improvised numerous "gadgets" to place the fertilizer in bands where adequate commercial equipment was not available.

Supplementary Fertilizer Applications

Results of studies to date indicate that best results are obtained when all of the phosphates needed by the crop are applied at the time of planting. Supplementary applications of nitrogen are often made later in the growing season, particularly if the appearance of the crop indicates that the nitrogen supply is becoming a bit low. Nitrogen and occasionally potash when added during the growing season are applied either as a sidedressing or with the irrigation water through the sprinkling system. The latter method is increasing in popularity.

TABLE III.—EFFECT OF FERTILIZER PLACEMENT ON YIELD OF VEGETABLE CROPS

Crop and Soil	Fertilizer		Placement*	Yield lbs/A	Increase lbs/A over broadcast	Value of increase less added harvest costs
	Kind	lbs/A				
Cabbage	15–10–10	600	Check	58,854	−9,680	−$72.60
			Broadcast	68,534	0	0
Sultan			2 Bands 2½″S x 4″B	72,213	3,679	27.59
silt loam			2 Bands 2½″S x 2″B	72,406	3,872	29.04
			2 Bands 2½″S x 3″B	74,439	5,905	44.29
			1 Band 2½″S x 3″B	74,826	6,292	47.19
Sweet Corn	5–15–10	500	Check	7,926	−435	−4.35
			Broadcast	8,361	0	0
Chehalis silty			1 Band 1″S x 1″B	9,183	822	8.22
clay loam			1 Band 2″B	10,245	1,884	18.84
			1 Band 2″S x 2″B	10,439	2,078	20.78
			1 Band 1″S x 2″B	11,261	2,900	29.00
Peas	0–20–20	300	Broadcast	3,248	0	0
Chehalis silty			Pre-drill	3,980	732	26.40
clay loam			1″ below seed	3,835	587	19.15
Pole Beans	5–15–10	600	Check	15,004	−1,839	−73.56
			Broadcast	16,843	0	0
Sultan			2 Bands 1″S x 1″B	17,908	1,065	42.60
silt loam			2 Bands 2″S x 4″B	18,586	1,743	69.72
			1 Band 2″S x 2″B	19,360	2,517	100.68
			2 Bands 1″S x 4″B	19,747	2,904	116.14

* S = to side of seed or plant. B = below level of seed.

Soil-fertility Losses . . .

(*From page* 26)

It was estimated that in order to maintain the organic matter of these soils at their original level it would be necessary to apply as much as 9.2 tons of clover hay per acre annually. Soil at Guthrie, Oklahoma, which had an average of about 46,000 pounds of organic matter per acre in 1931, suffered an average annual net decline of 1,860 pounds per acre when planted to cotton during the period 1931 to 1940 (5). When planted to a 3-year rotation of cotton, wheat, and sweet clover this decline was reduced to 940 pounds per acre. Soil with a sod cover of Bermuda grass accumulated organic matter at the rate of 1,700 pounds per acre annually instead of suffering a decline. The plots planted to cotton lost the equivalent of all the organic matter returned as crop residues and in addition 1,860 pounds annually of the original reserves. The soil devoted to the 3-year rotation lost all the crop residues returned during this period plus an additional 940 pounds of its original supply. At the same time, the land devoted to Bermuda grass sod held the equivalent of its original supply of organic matter and accumulated an additional 1,700 pounds per acre annually.

During this same period the continuous cotton plots lost by erosion an average of 18.9 tons of soil per acre annually, the rotation plots 4.2 tons, and the Bermuda grass plots 0.02 ton.

A light-textured soil in Alabama, which was so nearly level that it was considered practically free of erosion, lost, by erosion, 60 per cent of all the phosphoric acid applied as superphosphate to the crops grown on it in a 3-year rotation during a 26-year period (22). During the same period 82 per cent of the phosphoric acid applied as rock phosphate was removed by erosion.

The phosphoric acid was carried away in the clay fraction of the soil that was floated off the field by surface flow. The surface soil contained only 6 per cent of clay, yet the clay fraction held over 50 per cent of the soil's supply of phosphoric acid.

The application of 200 pounds of 16 per cent superphosphate per acre annually to pasture land in the Black Belt of Alabama gradually built up sufficient reserves of phosphoric acid in the soil, after several years, to support good plant growth. However, twice this amount of superphosphate was required per acre annually to support good growth when planted to cultivated crops. An application of 550 pounds of this same fertilizer per acre annually over a 5-year period failed to build up the phosphate carryover sufficiently to maintain cotton for 2 years on Hartsells sandy loam. This suggests a serious loss of phosphoric acid by erosion.

An inch of artificial rainfall applied to pasture land in Virginia at the rate of 3 to 3.75 inches per hour washed off 9.1 per cent of a 200-pound-per-acre application of triple superphosphate made just prior to the test (20). This loss was caused by only 0.2 inch runoff or 20 per cent of the water applied. Tests made at the same time with limestone of several degrees of fineness showed that the finer the material, the greater is its removal by erosion.

More Plant Nutrients Removed by Erosion Than by Crops

Total losses of phosphoric acid by erosion where no cover crop or other conservation practices were used were double the quantity removed by tomatoes or sweet corn in New Jersey (19). Where cover crops or cover crops and manure were used annually, the loss of phosphoric acid by erosion continued to equal the quantity removed by either crop.

The removal of potassium by erosion, where no conservation practices were employed, exceeded the removal of this element by tomatoes and was nearly equal to the removal by sweet corn. Where conservation practices were employed, the potassium removed by erosion was more than half as much as that by tomatoes and continued to exceed the quantity removed from the soil by sweet corn.

The loss of the fertility-bearing fractions of the soil must be prevented if the fertility of the soil is to be maintained (12). These losses vary greatly from storm to storm and from the beginning to the end of a given storm. The rate of loss of these fractions is influenced further by soil type, ground cover, and their concentration at the surface of the soil.

Efficiency of Fertilizer Lowered by Erosion

The loss of organic matter and plant nutrients from the soil by erosion reduces the efficiency of fertilizers. The selective removal of certain parts of the soil had a more profound effect on crop growth in New York than the depth of topsoil (14). Where erosion was due to the impact of falling raindrops, had been recent, and its detailed progress recorded, the application of liberal amounts of fertilizer failed to erase the effects of plant nutrient losses on plots which previously had been cropped for a number of years in such way as to permit different rates of erosion to occur.

Several series of plots on each of the four soil types were planted to several cropping systems and given a variety of cultural practices for a period of 11 years. The different treatments permitted varying rates of erosion during the period of study. The different rates of erosion produced vast differences in the yield of corn and the efficiency in the use of fertilizer the twelth year when the whole area was uniformly fertilized with 1,000 pounds per acre of 10-10-10 fertilizer and planted to corn.

On Bath flaggy silt loam the yield of corn ranged from 17 to 88 bushels per acre as a result of the difference in the loss by erosion which occurred during the preceding 11-year period. On a second soil type the yield ranged from 40 to 106 bushels per acre. On still a third soil type the corn yield ranged from 54 to 82 bushels per acre. Even following 2 years of alfalfa-clover-timothy hay on Honeoye soil, the corn yield varied from 49 to 69 bushels per acre. In every instance the yields were consistently related to the amount of erosion that had been measured during the 11-year period preceding the planting of corn. Plant nutrients and water in the soil were used inefficiently as was shown by the small top and root growth of corn.

Literature Cited

1. Bedell, Glenn D., Kohnke, Helmut, and Hickok, R. B. The effect of two farming systems on erosion from cropland. Soil Sci. Soc. Amer. Proc., 11: 522-526. 1946.
2. Bennett, H. H. Soil Conservation. New York. 1939.
3. Bryant, Jay C. and Slater, C. S. Runoff water as an agent in the loss of soluble materials from certain soils. Iowa State College Jour. of Sci., 22(3):269-312. April 1948.
4. Daniel, Harley A. The physical changes in soils of the Southern High Plains due to cropping and wind erosion and the relation between the $\frac{\text{sand-silt}}{\text{clay}}$ ratios in these soils. Jour. Amer. Soc. Agron., 28(7):570-580. 1936.
5. ————, Elwell, Harry M., and Cox, Maurice B. Investigations in erosion control and reclamation of eroded land at the Red Plains Conservation Experiment Station, Guthrie, Oklahoma, 1930-40. USDA Tech. Bul. 837. January 1943.
6. ———— and Langham, Wright H. The effect of wind erosion and cultivation on the total nitrogen and organic matter content of soils in the Southern High Plains. Jour. Amer. Soc. Agron. 28(8): 587-596. 1936.
7. Duley, F. L. and Miller, M. F. Erosion and surface runoff under different soil conditions. Mo. Agr. Exp. Sta. Res. Bul. 63. 1923.

Fig. 5. Fertility erosion in a cultivated field—organic matter, silt, and clay were separated from the sand by splashing raindrops. The washed sand, appearing as light-colored deposits between the rows, was left in the furrows.

8. Finnell, H. H. Monthly progress report, Soil Conservation Service Res. (Mimeographed). October 1949.
9. ———— Upkeep of Southern Great Plains wheatlands; Okla. Agr. Exp. Sta. Mimeo. Cir. M-204. August 1950.
10. Fly, Claude. A preliminary report of the chemical and mechanical analyses of dust deposited by wind at Goodwell, Okla. Panhandle Agr. Exp. Sta. Bul. 57. 1935.
11. Free, E. E. The movement of soil material by wind. U. S. Dept. Agr., Bu. of Soils Bul. 68. 1911.
12. Kohnke, Helmut. Runoff chemistry; an undeveloped branch of soil science. Soil Sci. Soc. Amer. Proc., 6:429-500. 1941.
13. Kucinski, Karol J. Valley soil erosion. The Springfield, Mass. Univ. June 30, 1946.
14. Lamb, John, Jr., Carleton, Everett A., and Free, George. Effect of past management and erosion of soil on fertilizer efficiency. Soil Sci., 70(5):385-392. 1950.
15. Middleton, H. E., Slater, C. S., and Byers, H. G. The physical and chemical characteristics of the soils from the erosion experiment stations. U. S. Dept. Agr. Tech. Bul. 430. 1934.
16. Moss, H. C. Some field and laboratory studies of soil drifting in Saskatchewan. Sci. Agr., 15:665. 1935.
17. Murphy, H. F. The disposition of dust in Central Oklahoma during the 1935 dust storm. Proc. Oklahoma Academy. 16. 1936.
18. Neal, O. R. The influence of soil erosion on fertility losses and on potato yield. Amer. Potato Jour., 20(3):67-69. 1943.
19. ———— Removal of nutrients from the soil by crops and erosion. Jour. Amer. Soc. Agron., 36(7):601-607. 1944.
20. Rogers, H. T. Losses of surface-applied phosphate and limestone through runoff from pasture land. Soil Sci. Soc. Amer. Proc., 7:69-76. 1942.
21. ———— Plant nutrient losses of erosion from a corn, wheat, clover rotation on Dunmore silt loam. Soil Sci. Soc. Amer. Proc., 6:263-271. 1941.
22. Scarseth, George D. and Chandler, W. V. Losses of phosphate from a light-textured soil in Alabama and its relation to some aspects of soil conservation. Jour. Amer. Soc. Agron., 30(5):361-374. 1938.
23. Slater, C. S. and Carlton, C. A. The effect of erosion on losses of soil organic matter. Soil Sci. Soc. Amer. Proc., 3:123-128. 1938.
24. ———— Variability of eroded material. Jour. Agr. Res., 64(4):209-219. August 15, 1942.
25. Wilson, J. K. and Schubert, H. J. The microflora in the soil and in the runoff from the soil. Jour. Amer. Soc. Agron., 32(11):833-841. 1940.
26. Zingg, A. W. and Chepil, W. S. Aerodynamics of wind erosion. Agr. Engin. 31(6):379-382. 1950.

Rotation Fertilization

(*From page* 20)

As farmers become better acquainted with the factors involved in crop production, they are better able to evaluate specific conditions and utilize fertilizer recommendations. Soil-testing procedures are much more accurate today and should be used to achieve more efficient fertilizer usage. Soil tests performed by competent personnel have enabled the farmer to obtain a better idea of the amounts and kinds of nutrients to add.

Farming has become a keenly competitive enterprise. Costs and operation efficiency vary greatly from one farm to the next, but the fertilizer bill is still one of the highest costs even on the most efficient farms. Rotation fertilization is an attempt to drive the efficiency on all farms upward.

Tillers and Tellers

(*From page* 5)

sees in all this a greater need than ever for expert farm management.

The kind and amount of loans to farmers which are not in the real estate class—loans for working assets —are watched with eagle eyes these days. As of last January the total of non-real estate loans to U. S. farmers was about $6 billions. Such working and production loans have some impact on the real estate credit field. Here, too, men who handle loans in all categories have been pondering about one-package loans or other kinds known as variable-payment loans, such as Farmers Home Administration discovered and used back when it was the Farm Security Administration. Only three states had smaller sums outstanding in non-real estate loans than they had a year ago—Vermont, North Dakota, and Arkansas. The largest increases were where we'd look for them most, in Iowa, Illinois, Nebraska, and Kansas.

A country banker affirmed the general reports that commercial banks during 1950 added to their non-real estate loans to farmers by 23 per cent. Livestock loan companies and agricultural credit corporations do not have a relatively high level of such loans compared to the production credit associations. Farmers had to have new machinery and supplies to reach out and keep step with the higher goals made necessary by the national defense effort. Non-real estate credit to farmers last January was 102 per cent of the figure when the last world war ended. Since 1945 the borrowing for this reason has expanded about 18 per cent each year. Although this form of debt is hitting close to the record point, few see any signs that it is excessive when matched with the expanding farm income.

Now the trust a banker holds is an asset to his community as a whole. Or it may be a liability, if he is as poor a financial manager as the farmer with whom he places a risky loan. Irate farmers "took it out" on probate judges and country bankers back in those hectic, riotous times when "deficiency judgments" were trying to get blood out of shrunken turnips.

Probably the greatest pitfall and booby trap in the galaxy of the banks which make short-term working loans and take chattel mortgages are that there is not enough sound background information collected on a borrower. When things go sour for such a reason the confidence of the community is shaken and everyone suffers a little.

Legal forms and documents are easy to get and fill out when a lender takes a chattel mortgage. The notes are simple and convenient. The execution of the papers is a matter of swift and ordinary routine. The clerk of the township accepts and files them and we think the deal is settled.

IT'S tough on the mortgagor to find out when almost too late that the mortgagee has only a small equity in his farm or in a piece of what was imagined to be unincumbered real estate in the village. Then, in other cases, the property is in the name of the borrower's wife although her signature was not put on the chattel paper. Sometimes a contract to purchase, or land contract, is the nearest thing to a "clear title" which the borrower possesses. Or the chattel mortgage may be recorded in the wrong township through confusion with his mail address.

Experts in getting into and out of such dilemmas will also warn you that possession of equipment by a farmer doesn't signify that he is its true and legal owner. The tractor or the combine may be borrowed or rented, and some relative may have a half interest in a motor truck. The young stock in the pasture and the pigs in the pen may belong to a neighbor.

Not only is a full knowledge of the affairs of the farm a wise essential to a successful short-term operating loan, but experience has taught bankers and other lenders that you also must keep a check on the subsequent happenings out there—just in case.

Hawkshawing and snooping are not nice practices, but if they help to keep up lending morale and faith, they are useful. Quite often all is well and no untoward circumstances arise. And then, again, it pays to be alert.

Take a case where a fellow has a sizable herd of fair-producing cows with which to make good on the loan. It's a jolt to find out later that this promising herd has dwindled to five or six of the least milky ones. Naturally, a lender on chattels is often protected by state laws that say it is a misdemeanor to dispose of mortgaged property—but it's no protection against headaches and no sure way to recoup the loss.

A buyer of mortgaged chattel property is required either to hand back the said forfeited goods or make himself financially liable on what is called a "suit for conversion."

One of the best legal specialists in this field tells of a case where a cattle dealer frankly admitted that he purchased cows covered by chattels. He also asked the lender to come to his stockyard and pick out the ones that were "hot property." The joker in this loaded deck was simply that the chattel mortgage did not identify the exact cows or describe them in a way that enabled the mortgagee to select what belonged to him.

Not long ago a farmer asked for money and executed a chattel mortgage on a bunch of cows which he claimed he had just bought from a neighbor. The ear-tag numbers and such identification were supplied and properly stuck into the document for safety's sake. Subsequently it developed that the farmer had only discussed the cattle deal with his neighbor and had taken down the ear-tag numbers, without buying them. Instead he went down to a stockyard and secured some inferior cows. This upset the apple cart indeed for the chattel holder.

If a borrower gives a lender a mortgage on specific cows named and identified as such, and there is a special proviso in the paper which says it also covers cows he may later buy and own,

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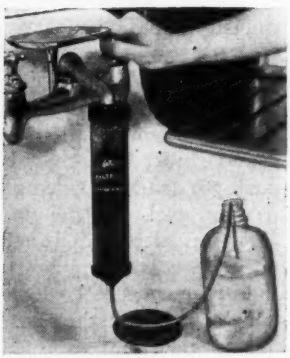

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what will happen if somebody else buys or attaches or takes a mortgage on the new cows acquired since the original chattel was issued? The answer seems to be that only the cows he owned when he made the mortgage are forfeited. This is just another ramification to make the loan business a joy forever.

QUITE often a good, decent farmer wants to retire and so he decides to hold an auction sale. But he has some property under chattel mortgage and objects to this being mentioned at the sale. Here is just one more pitfall common to the chattel business. All bother can usually be headed off by having an agreement signed by the borrower and lender. It would state that the lender agreed to having the chattels offered in the auction sale, but that there was a lien on certain goods, the proceeds from which must be kept separate by the auctioneer as a trust. There is also a risk that another creditor may show up suddenly and buy a few articles at the auction, and then try to have their value offset against the debt due him. So you can easily see why there is always a thrill about an auction—and it's not always a tear-jerking throb for the old homestead's demise, or a vague hunt for antiques.

Money makes the mare go, and nowadays has other more complex agricultural duties and responsibilities to perform. We have plunged headlong into a vortex of commercial farming. Farms are indexed more or less in types as to their prevailing source of income. The risks are written large and clear for each and every type, all part of the business of sound credit with which to fill our national cupboards and larders.

I think no discussion so brief as this about farm financing should omit to credit the banking fraternity and the government credit agents for devising and preparing a far better background of information and understanding than the country enjoyed in my youth.

At first this took the form of country banking societies, then state societies, each of which had a special agricultural committee. Out of this grew a system of farm experts who worked for one or more banks—sort of county agents in finance. They knew the countryside so well and were conversant with so many pitfalls and profitable ventures alike that few cases stumped them—and more sound loans were made.

There was a time, too, when foreign investments and big city projects attracted so much eager capital from country banks that the balance on hand with which to satisfy the normal and justifiable financial needs of the rural operators dropped to discouraging and alarming levels. To be utterly frank about it, this has happened also with government and civic bond issues—competing for stability and security against the agricultural assets of the nation.

SO farmers have had to fight for credit sometimes against rather formidable competitors. This is one reason for the rise of the insured farm credit systems. Many perfectly honest tenants desiring to become owners of farms were unable to find local means to fit their pioneer situations, unless they sought this special credit available on terms a beginner could meet and yet live and prosper.

Thus on the whole, times have improved in relation to the extent of credit, and farmers don't regard such debts with the aversion that once stirred their souls to prejudice against the man behind the wicket. That they themselves have snug deposit balances is the No. 1 reason. Someday a real figure philosopher who knows all the twisted strands of farm financial history will dish himself up a book about it. I'll bet no country vet or busy sawbones can tell a story more replete with the stuff that makes Americana.

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It happened in one of the large training camps. A rookie who had just recently arrived was walking down one of the paths when he met a commissioned officer. The new arrival failed to salute.

The officer stopped him and said: "Say, buddie, do you see those leggings?"

The rookie looked admiringly at the shining leather puttees and said: "Yeh, look at the damned things they gave me."

* * *

Conversation between two English professors:

"Is your wife entertaining this Fall?"

"No—not very."

* * *

The freshman's father paid his son a surprise visit. Arriving at 1 a.m., he banged on the fraternity-house door. A voice from the second floor yelled, "Whatdya want?"

The father answered, "Does Joe Jones live here?"

The voice answered, "Yeah, bring him in."

* * *

There was quite a flurry when it was discovered that at every Sunday School session the little fellow was praying, "Lead us not into temptation, but deliver us some evil."

* * *

He: "We certainly had a big time last night for ten cents."

She: "I'll say! Wonder how little brother spent it?"

A beautiful coed (from some other school) was wearing a blue sweater: it was one of those marvelous form-fitting kind.

Said she, coyly: "Don't you think it brings out the blue in my eyes?"

He: "Gulp."

* * *

A Metropolitan Symphony Orchestra had given a special performance in a small New England town. It was a new experience for many of the inhabitants. The next day some of the old-timers, gathered around the stove in the general store, were expressing their opinions of the concert.

"Well, all I got to say," commented one old character with finality, "is that was a danged long way to bring that bass drum to bang it only wunst."

* * *

Poor old Hiram! He went up to New York determined to make his living pulling some skin games on innocent strangers. However, the first fellow he tried to sell the Brooklyn Bridge to turned out to be the owner of the darned thing, and if Hiram hadn't paid him ten dollars to keep quiet they would have had him arrested.

* * *

A girl telephoned her sweetheart.

Girl: "You better not come over tonight. Daddy is mad. He found out that we used his car for joy-riding last night."

Boy: "How did he find out?"

Girl: "We hit him."

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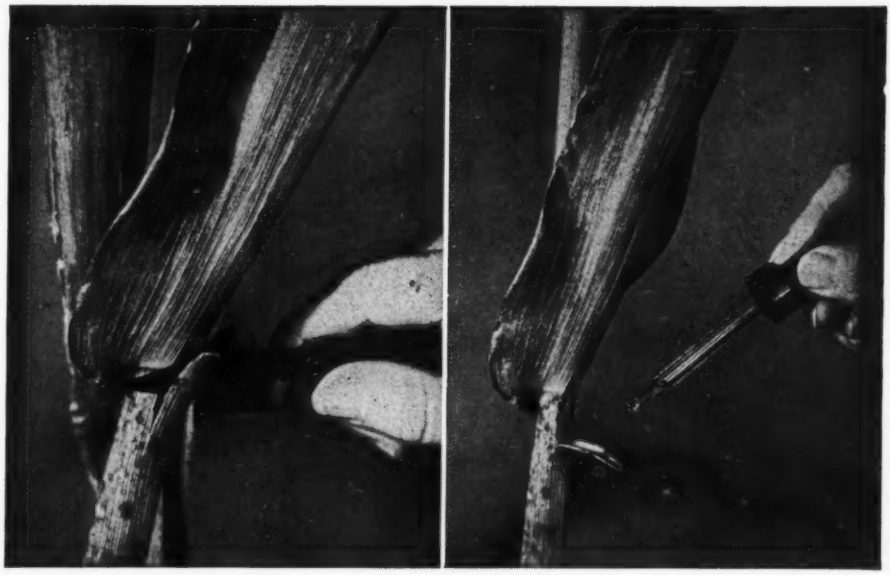
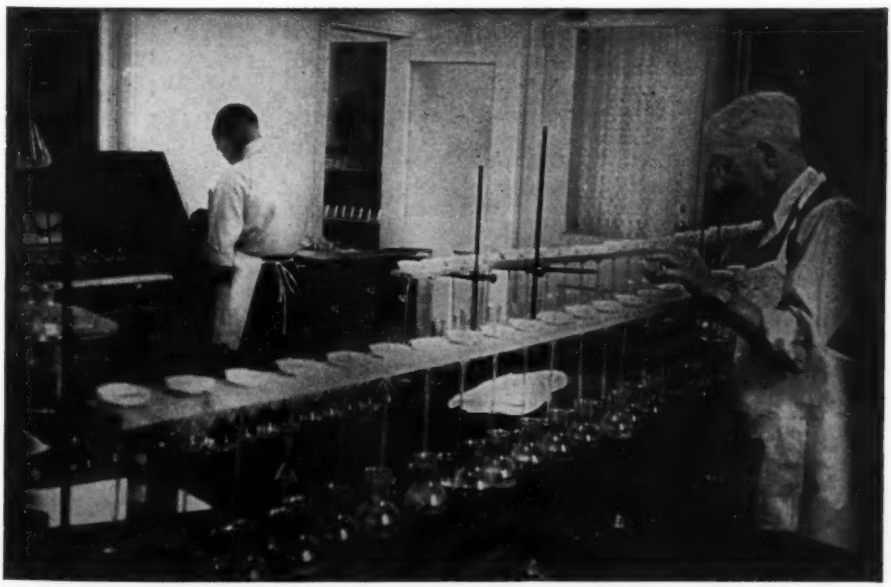


Nitrate tests can be made at the base of the leaf midrib without destroying the entire plant. This is an important consideration in making numerous tests on small experimental plots. The height of the plant at which nitrates are present as well as the intensity of the blue color gives an indication of the nitrate status of the plant.



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